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The Marine Corps Automated Food Service Operations System (MCAFSOS) project, initiated as a result of the Defense Audit Service's audit of the DoD Food Service Program in May 1980 and the General Accounting Office's report to the Secretary of Defense on DoD Food Service needs and improvements in October 1981, was implemented and tested in three messhalls at the Marine Corps Development and Education Command (MCDEC) Quantico, VA, between April and November 1986. The automated system, developed at the US Army Natick Research, Development and Engineering Center, was based on the IBM Series/1 minicomputer and covered forecasting, meal production, accounting, inventory, and file maintenance functions at the messhall level.

Test results indicated that the automated system was preferred to the manual system because it significantly reduced the amount of time required to process food service forms.

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MARINE CORPS AUTOMATED FOOD SERVICE OPERATIONS SYSTEM TEST REPORT

BY

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FINAL REPORT APRIL 1984 TO NOVEMBER 1986

UNITED STATES ARMY NATICK
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ADVANCED SYSTEMS CONCEPTS DIRECTORATE

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SUMMARY

The Marine Corps Automated Food Service Operations System (MCAFSOS), designed to enable Marine Corps messhall food service to exercise better management control and to perform necessary routine calculations at the messhall level, was field tested at the Marine Corps Development and Education Center (MCDEC), Quantico, VA, April to November 1986.

Terminals and printers were installed in three messhalls and were interfaced with the host computer (IBM Series/1 minicomputer) in the Food Service Office (FSO) where additional terminals and printers were installed. A communication link was established with the US Army Natick Research, Development and Engineering Center, allowing software support from Natick. Forecasting, Meal Production, Accounting, Inventory, and File Maintenance Modules were tested. A Security and Directory Module and a System and FSO Functions Module were also tested. An optional Access Control/Automated Headcount Module was designed, but not tested or adopted.

The automated system was assessed using an acceptance questionnaire and work sampling techniques. Results indicated that MCAFSOS was satisfactory and was preferred to the manual system. Both work sampling and questionnaire results indicated a significant reduction in the amount of time required to complete most food service forms. There was a 55% (according to the questionnaire) to 76% (according to work sampling) reduction in the amount of time required to complete food service forms that were used on a daily basis; the greatest time savings were associated with the Stock Record and Inventory Control Card.

PREFACE

The Marine Corps Automated Food Service Operations System (MCAFSOS) was developed in response to the Joint Service Requirement (JSR) AFNM 81-21 (III), ADP Support for USMC Food Service (MSR 1427). The majority of MCAFSOS was developed at the US Army Natick Research, Development and Engineering Center, April 1984 to January 1986, and was tested at the Marine Corps Development and Education Command (MCDEC), April to November 1986.

The author is greatly indebted to the computer science students who analyzed the Marine Corps Manual Food Service System at MCDEC and coded the automated system as part of their cooperative education or internship programs. The staff included (at different times) Mr. John Keating, Mr. John Tavares, Mr. Gregory Przybyl, Mr. John Ciccarelli, Mr. Michael Courtemanche, Mr. Steven Bowen, and Ms. Beth Silver. I am especially indebted to Ms. Teresa Thanos, who coordinated the initial designing and coding of the automated system, and Ms. Mary Moreschi, who coordinated the project in its latter stages. The author also wishes to thank Ms. Jane Benson who edited the user guide, Ms. Katrina Schuh and Ms. Angela Thompson who assisted in the collection and analysis of data, and Mr. Michael Statkus who edited this manuscript.

The author wishes to gratefully thank Mr. James Hamilton and Mr. Barnett Thompson, Central Design and Programming Agencies, USMC, and Mr. David Winslow, Field Engineer, International Business Machines (IBM), who provided much needed support and technical guidance throughout the project. Finally, thanks is due to MC Food Service and ADP Personnel who supported the project throughout its course.

TABLE OF CONTENTS

	Page
SUMMARY	iii
PREFACE	iv
LIST OF FIGURES	vi
LIST OF TABLES	vii
INTRODUCTION	1
Purpose	1
Background	1
Project Objectives	2
MANUAL SYSTEM	3
Access Control/Headcounts	5
Feeding	6
Financial Control	7
AUTOMATED SYSTEM	10
System Hardware	10
System Software	20
AUTOMATED SYSTEM DESIGN	22
Reports	22
Application Software	22
Access Control/Automated Headcount	31
System Timing Requirements	44
Failure Contingencies	45
AUTOMATED SYSTEM IMPACT	46
Procedures	46
Worker Assessments	47
Worker Comments	47
Time Savings	49
Automated Forecast	49
REFERENCES	52
APPENDIXES	
A. Data Collection Forms	53
B. Definitions of Activity Codes	59
C. Food Service Worker Comments	63

LIST OF FIGURES

Figure		Page
1.	Food Service System General Data Flow.	3
2.	Food Service System Functional Chart.	4
3.	Food Service System Specific Data Flow.	5
4.	Hardware Configuration.	13
5.	Hardware Configuration of Messhall 2000, Bruce Hall.	14
6.	Hardware Configuration of Messhall 5000, Bobo Hall.	15
7.	Hardware Configuration of Messhall 2109, Air Facility.	16
8.	Configuration of Interfacing Cables.	17
9.	Hardware and Software Configuration.	18
10.	Required Terminal Features.	19
11.	System Operational Overview.	23
12.	Interrelationship of Access Control Programs.	29
13.	Interrelationship of Validation Program, Communication Program, and Card Readers.	30
14.	Magnetic Stripe Meal Card Control Records.	33
15.	Point of Sale (POS) Terminal Keypad Design.	35
16.	Access Control Procedures.	40

LIST OF TABLES

Table		Page
1.	System Costs.	11
2.	Estimated Kilobytes RAM Used in Each of Eight 64KB Partitions: Actual Configuration.	18
3.	Estimated Kilobytes RAM Used in Each of Eight 64KB Partitions: Possible Operational Configuration.	19
4.	Communication Times in Seconds for 1000 Consecutive 80-Character Lines of Code Sent From the Series/1 to Either One or Two Terminals With and Without MUX.	19
5.	Degradation in Seconds for Each of Two Terminals per 80-Character Line of Code Due to Statistical Multiplexer Using Communication Times for One Terminal With Mux as Baseline.	20
6.	Application Programs by Module.	24
7.	Master SIK File Description.	34
8.	POS Terminal Numeric and Function Key Use.	36
9.	POS Terminal Backup Functions.	36
10.	Communication Hardware Required for POS Terminals.	37
11.	Branch of Service Categories and Methods of Payment.	37
12.	Validation Program Functions.	41
13.	Card Infraction Messages.	42
14.	Credit Customers Without Cards: Reasons, Day Limitation Schedule, and Infraction Messages.	43
15.	Worker Assessment of the Automated System.	48
16.	Self-Report Estimates of How Much Time Was Spent on the Computer Each Day.	48
17.	Work Sampling: Time Distribution in Minutes for Personnel Under the Manual and Automated Systems.	50
18.	Self-Report Estimates of How Much Time Was Required to Complete Forms Under the Manual and Automated Systems.	50
19.	Forecasted and Actual Attendance at Messhall 2000.	51
20.	Forecasted and Actual Attendance at Messhall 2109.	51

MARINE CORPS AUTOMATED FOOD SERVICE OPERATIONS SYSTEM TEST REPORT

INTRODUCTION

Purpose

The Advanced Systems Concepts Directorate at the US Army Natick Research, Development and Engineering Center was tasked to develop and test a Marine Corps Automated Food Service Operations System (MCAFSOS) for messhall level operations that would improve management control and perform routine calculations. The system duplicated manual operations as specified in MCO P10110.14K (Food Service and Subsistence Management Manual) and provided a prototype for the Marine Corps Food Management Information System (MCFMIS).

Background

The Defense Audit Service (DAS) Report on the Audit of the Department of Defense (DoD) Food Service Program, dated 28 May 1980, cited serious deficiencies in troop feeding headcount and inventory controls which cost the Armed Services millions of dollars annually. The audit was requested by the Deputy Assistant Secretary of Defense (Supply, Maintenance and Transportation) because service audit reports repeatedly cited similar deficiencies.

In the report, the DAS recommended that an automated food accountability and control system be established for all ashore enlisted dining facilities. The system would use plastic meal cards, electronic cash registers, and item pricing. Subsequently, a DoD Food Planning Board Joint Service Task Group developed a set of specific proposals for implementing DAS recommendations.

An incremental program was envisioned for short-term development of an automated headcount system. This system would establish diner eligibility to receive meals at government expense by using the plastic Armed Forces Identification (ID) card that is currently being developed by the Deputy Assistant Secretary of Defense (Military Personnel Policy). The headcount system would establish diner eligibility and record headcount and dollar sales data. This information would be input to the dining facility accounting system for summarization, audit, and reporting purposes. Systems would be developed for both food service programs using a la carte (item pricing) and for those food service programs where a la carte is not feasible. It was felt that an automated headcount application would bring under control the majority of the deficiencies cited in the DAS report. However, the Food Planning Board Task Group further recommended that, in the future, the feasibility of automating the accounting system, subsistence issue to dining facilities, dining facility inventory control, and menu planning/production should be evaluated.

In 1981, the General Accounting Office (GAO) reviewed food service operations at 17 military locations and described its findings in a report to the Secretary of Defense. Among other recommendations, the GAO advocated improved accountability over food stock, controlled access to dining facilities, and uniform management.

The US Army Natick Research, Development and Engineering Center (NRDEC) was tasked by the Assistant Secretary of the Army for Research, Development and Acquisition (RD&A) to provide maximum support for the service research and development requirements of the DoD Food Service Automation Program. All services were requested by the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics) to fully support and fund the automation of the headcount procedure and the automation of those accounting functions that were thought to be feasible. Automated data processing (ADP) support for US Marine Corps (USMC) Food Service was initiated in FY83.

As originally conceived, MCAFSOS was to automate all base level food service operations, including the headcount function, and was to be field tested in three messhalls and a Food Service Office. In July 1985, in order to facilitate development of the prototype system, the requirement for an automated headcount (and access control) system was dropped. Also, in 1986, because only three of a seven mess hall system were being automated, the requirement to automate food service office operations was eliminated. As a consequence, MCAFSOS was restricted to messhall operations. However, the headcount function and Food Service Office operations were analyzed and coded even though they were not field tested.

The field test was conducted April to November 1986 at the Marine Corps Development and Education Command (MCDEC), Quantico, VA and covered all phases of messhall level food service accounting, inventory control, and meal production. Three messhalls (buildings 2000, 5000, and 2109) were automated and interfaced with the Food Service Office.

Project Objectives

- Provide accurate and timely inventory control data by automating records of all receipts, issues, and adjustment of each item in inventory and by providing an audit trail for all reconciliations.

- Reduce the number of inventory items and the average dollar value of inventory items.

- Provide accurate and timely accounting data by using headcount and subsistence issue data and automating report preparation.

- Provide automated menu production guidance including all recipe data, required quantities of ingredients, number of portions to prepare, and method of preparation.

- Reduce the time required to produce food service records and worksheets.

MANUAL SYSTEM

The food service general data flow chart is shown below in Figure 1. Marine Corps Headquarters prepares a partial Basic Daily Food Allowance (BDFA) amount and sends it to the installation Food Service Office prior to the beginning of each month. The BDFA is the prescribed cost to feed one person per day and is based on the food cost index, a representative list of specified quantities of food items prescribed by DoD. In addition, headquarters issues quarterly fund authorizations to the Food Service Office. The authorizations are based on: (1) budget estimates (broken down by quarter) submitted by the Food Service Office at the beginning of each fiscal year; and (2) quarterly updates to the estimates. The Food Service Office completes the BDFA by adding the local cost of bread and milk. The complete official BDFA amount is then sent to the dining facility to be used along with headcount figures to compute daily monetary credits. Headcount figures are used along with subsistence expense to compute the daily cost to feed one person. The dining facility adjusts its menu to keep its cost to feed one person as close as possible to the official BDFA.

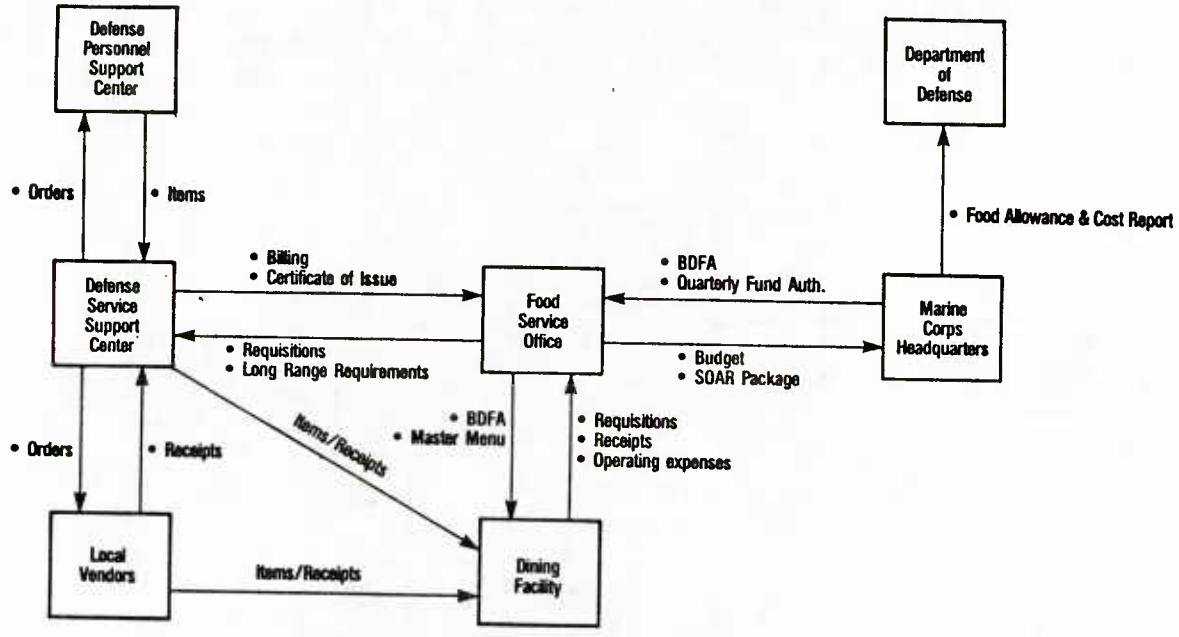


Figure 1. Food service system general data flow.

The Food Service Office prepares a master menu which is used by the dining facilities for acquiring food items and preparing meals. The Food Service Office uses the menu to prepare long-range subsistence requirements. The installation's Defense Service Support Center (DSSC) uses these subsistence requirements to replenish its subsistence stocks from the Defense Personnel Support Center (DPSC). The dining facility uses the menu and headcount forecasts to determine its daily subsistence needs and to prepare food preparation

reports. The facility also uses the menu to order food items from the DSSC through the Food Service Office, and uses the DSSC and vendor receipts to update its financial status. The DSSC sends to the Food Service Office billing lists for each dining facility order and a consolidated billing for all dining facilities (Certificate of Issue) for the month.

The dining facility forwards operations cost, headcount data, and receipts to the Food Service Office for consolidation with the same information from other dining facilities. The Food Service Office uses this information, along with the Certificate of Issue, to prepare the monthly Subsistence Operational Analysis Report (SOAR). The SOAR and supporting documentation make up the SOAR package, which the food service office sends to Marine Corps Headquarters each month. Marine Corps Headquarters prepares a monthly financial worksheet from the SOAR packages. This worksheet is used to maintain various accounting ledgers and to prepare a Food Allowance and Cost Report for the DoD.

Figure 2 shows the hierarchical breakdown of the functions performed in the operation of the Marine Corps food service system. The chart shows that the system consists of three major functions: (1) controlling access to the dining facility and counting the number of people who eat at the facility; (2) feeding dining facility patrons; and (3) providing financial control of the system. The functions are linked through the flow of the data between them as shown in Figure 3.

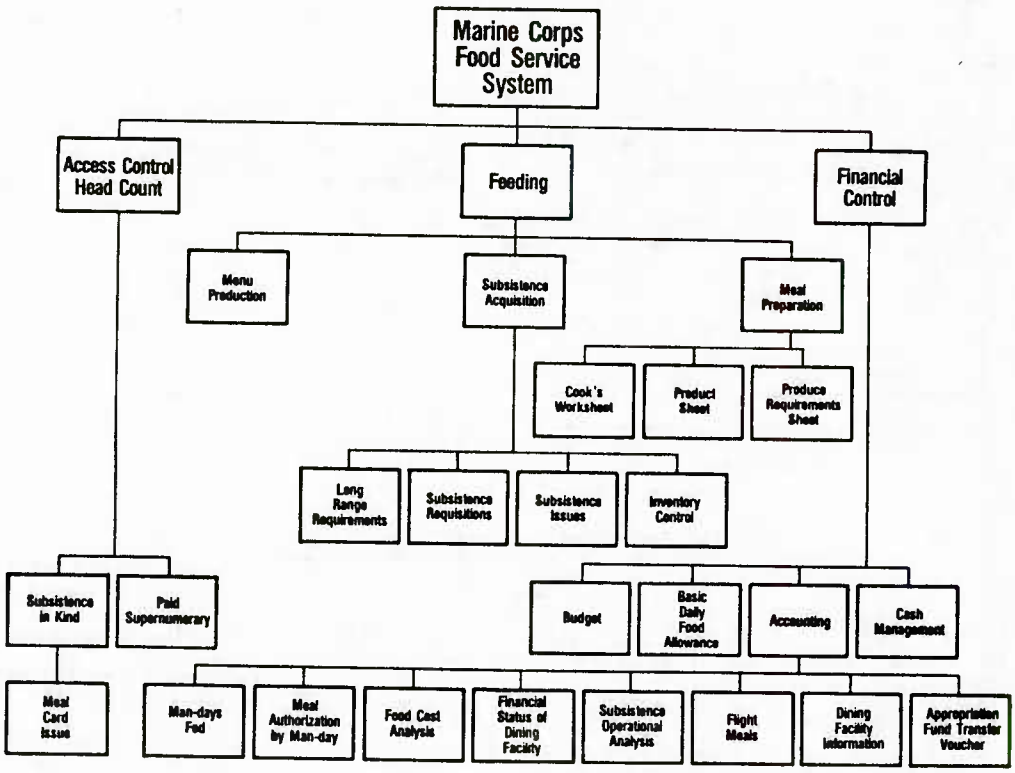


Figure 2. Food service system functional chart.

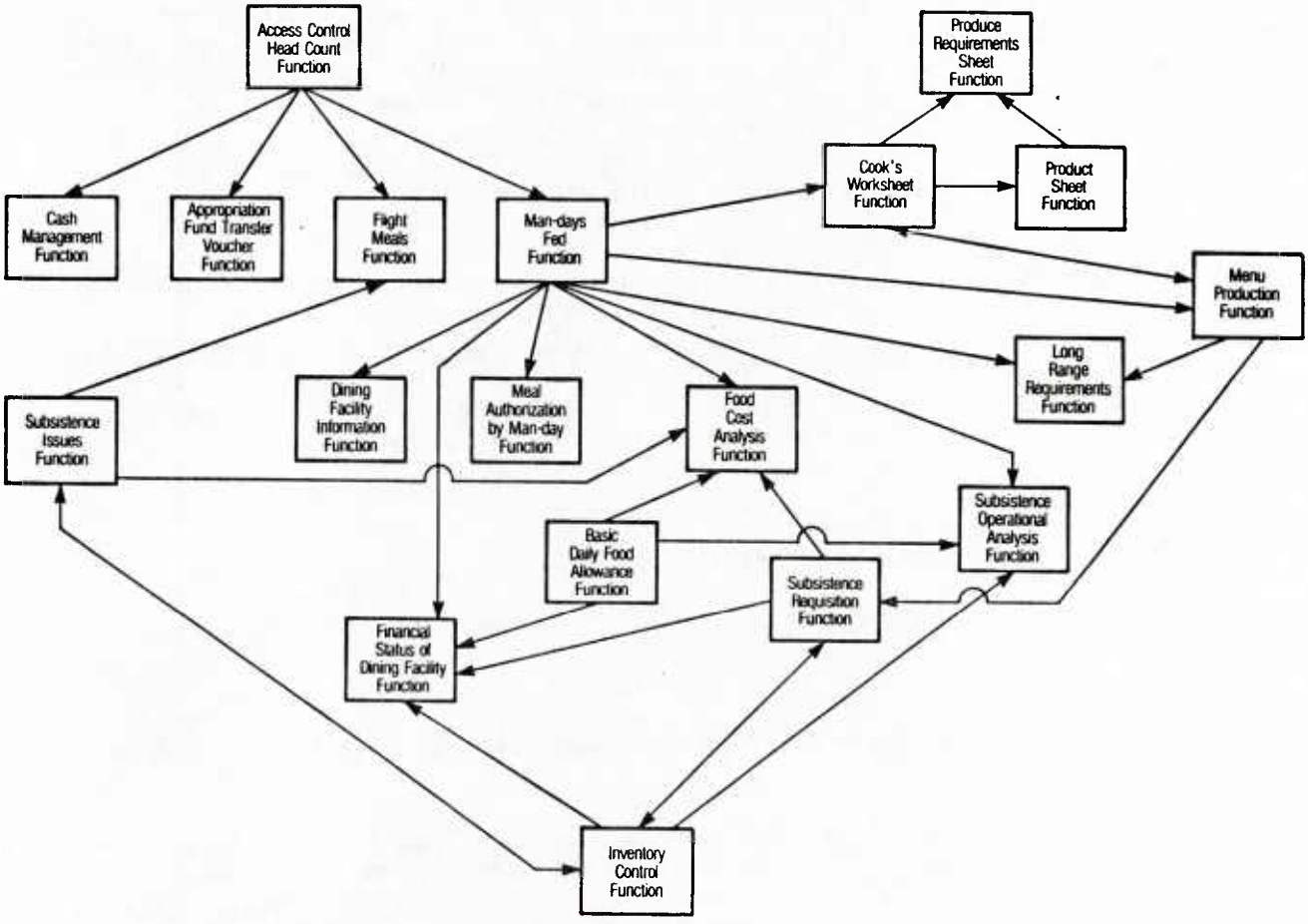


Figure 3. Food service system specific data flow.

Access Control/Headcounts

There are two kinds of people who eat in dining facilities--those who eat at government expense and those who pay cash. Under the manual system both groups must sign for their meal. The signatures of those who eat at government expense represent the headcount data used along with the BDFA to compute the monetary credits. The headcount data and subsistence expenses are used to compute the daily cost to feed one person.

Subsistence in Kind (SIK). These are people who are authorized to eat at government expense. Each dining facility has one or more SIK check-in points, each point monitored by a signature record supervisor. The SIK diner displays a meal card and ID card and signs the "Meal Signature Record" form for his or her "category of personnel". There must be a separate form for each "type of

meal" and "category of personnel". Various groups of people (such as recruits) are checked using the block signature method on the "Meal Signature Record" form. After each meal the meal signature supervisor collates the "Meal Signature Record" forms by "type of meal" and "category of personnel" and counts the number of signatures on each sheet. These totals are used for the preparation of: (1) the daily "Man-Day Fed Report", (2) the "Flight Meal Certificate", and (3) the "Voucher for Transfers Between Appropriations and/or Funds".

Paid Supernumerary. These are people who are not authorized to eat at government expense and who pay cash for their meals. Each cash customer signs the "Paid Supernumerary Ration Register", enters his or her grade, rank, or type of personnel (e.g., cadet, child), the "food cost", and the "surcharge" (if any). Various groups of people may be checked in using the block signature method. This method permits one person to indicate receipt of a meal for a group of people, such as high school students or Boy Scouts.

Feeding

Feeding includes three major functions:

- the preparation of the dining facility's master menu (Menu Production);
- the acquisition of food items (Subsistence Acquisition); and
- the determination of food item and quantity requirements for each meal (Meal Preparation).

Menu Production. Each installation operating a dining facility must establish a menu planning board whose purpose is to plan the master menus for the installation. The menus cover a 1-year period and are derived from the "42-Day Armed Forces Menu" (MCO P10110.35) and the "Armed Forces Recipe Service" recipe cards. Master menus are used in preparing long-range subsistence requirements, the "Inventory, Requisition, and Issue" forms, and the "Cook's Worksheet".

Subsistence Acquisition. Subsistence Acquisition includes producing long-range subsistence requirements (Long-Range Requirements), acquiring food items from sources of supply (Subsistence Requisitions), withdrawing food items from dining facility storage areas (Subsistence Issues), and recording and controlling the receipt and issue of food items in the dining facility (Inventory Control).

The Long-Range Requirements function is the means by which the Food Service Office projects its food item requirements over an extended period of time. It is based on the master menu, the "Armed Forces Recipe Service" recipe cards, pounds of product required per 100 individuals, the item acceptability factor, and the estimated number of people to be fed for the period covered by the projection.

The dining facility prepares Subsistence Requisitions by using the master menu, recipe cards, usage points (pounds/volume based on 100 portions required on an average day), consumption periods, and subsistence stock levels on hand. The facility forwards the requisition form to the Food Service Office which in turn forwards it to DSSC. The DSSC fills the orders and enters the following data on the requisition forms for each item requested: the quantity "issued", the "unit price", the "extended cost for the quantity issued, and the total cost

of all items on the form. The DSSC forwards a copy of the form to the Food Service Office and a copy to the dining facility with the items issued. Local purchase items are delivered by the vendor to the dining facility along with a receipt, a copy of which is forwarded to the Food Service Office. The Food Service Office uses the forms and vendor receipts to update the "debits" portion of the "Financial Status of Dining Facility" form. The dining facility uses the forms and vendor receipts to update its "Stock Record and Inventory Control Card" and to prepare the daily "Food Cost Analysis" report.

The Subsistence Issues function is the means by which the quantity of subsistence items required for each meal is determined and their issue from dining facility storage areas to the kitchen is recorded. Issues for 1 day are recorded by meal on the "Subsistence Issue Receipt" form. The total value of issues by category and meal is recorded on the "Food Cost Analysis" report. The total quantity issued for each day is used to update the "Stock Record and Inventory Control Card".

The purpose of the Inventory Control Function is to record the receipt and issue of subsistence items in dining facility storage areas. A separate "Stock Record and Inventory Control Card" is maintained for each subsistence item. Each time the quantity of an item is changed, the "date", "document number", and "type of transaction" must be recorded. The increase or decrease in the amount of the item and the effect it has on the amount "available for issue" and the "accountable balance" must also be recorded. The "accountable balance" is the amount of the item that should be in stock, as opposed to the actual amount or "available for issue". The amount "available for issue" is adjusted immediately as the result of a survey or inventory, while the "accountable balance" is not changed until the adjustment has been approved through the use of an adjustment voucher letter that states the reason for the adjustment. In addition, a physical inventory is taken at the end of each month using the Navy Marine Corps (NAVMC) "Inventory, Requisition, and Issue" form.

Meal Preparation. Meal preparation includes: the listing of the menu for the day by meal and item (Cook's Worksheet); the recipe adjustment and instruction forms (Product Sheet); and the listing of produce required for each meal (Produce Requirements Sheet). The Cook's Worksheet indicates the menu to be prepared for a meal. After the meal, items that were short or over in terms of portions prepared are accounted for in the "short", "save", and "discard" columns on the worksheet. These figures and portions prepared are used to determine the number of meals served. The number of meals served is the basis for computing the items acceptability factor. The Product Sheet is used to make adjustments to a recipe in order to prepare the proper quantity of the recipe ingredients as required by the recipe batch size. The recipe ingredients, quantity to prepare, and method of preparation are listed on the Product Sheet. The Produce Sheet is used to inform the dining facility's vegetable preparation room of the produce requirements for each meal of the day.

Financial Control

Budget. Marine Corps activities receiving field allotments for subsistence must submit an estimate of subsistence funds required for the fiscal year, by quarter, to the Commandant of the Marine Corps by 1 September each year. During the fiscal year they must submit revised quarterly estimates by the beginning of the third month of each quarter.

Basic Daily Food Allowance (BDFA). The basic daily food allowance (BDFA) is a prescribed quantity of food, defined by components (food items) and money value, that is required to provide a nutritionally adequate diet for one person for 1 day (not to exceed three meals). The components on which the BDFA is based are taken from the Food Cost Index, which is a list of specified quantities of food items prescribed by DoD. Marine Corps Headquarters sends a partial BDFA in letter format to each food service office where the final BDFA is computed by adding the value of the bread and milk allowances for one person. The BDFA is computed monthly.

Accounting. Accounting includes the following functions: the computation of the number of man-days fed (Man-Days Fed); the monitoring of a dining facility's inventory status and cost to feed (Food Cost Analysis); the monitoring of the relationship of a dining facility's monetary credits to its subsistence expenses (Financial Status of Dining Facility); the preparation of an installation's monthly financial status of the food service system (Subsistence Operational Analysis); the accounting for the sale of flight meals (Flight Meals); the preparation of an installation's quarterly status of the food service system (Dining Facility Information); and the preparation of the voucher for reimbursement for meals served to personnel from organizations authorized to eat at government expense in Marine Corps dining facilities (Appropriation/Fund Transfer Voucher).

The purpose of the daily Man-Days Fed Report is to compute the number of man-days fed by a dining facility during a 24-hour period beginning with breakfast or brunch. Man-days fed is the number of individuals who attended a meal by branch of service multiplied by a conversion factor. The conversion factor weights the meal for dollar value and converts the meal to rations. The dining facility enters the man-days fed data daily on the "Man-Days Fed Report" and forwards the report to the Food Service Office. The Food Service Office uses the report to complete the "Financial Status of Dining Facility" report and the monthly "Man-Days Fed Report", a consolidation of the daily reports using the same report form. The monthly "Man-Days Fed Report" is part of the SOAR package sent to Marine Corps Headquarters each month.

The Food Cost Analysis function is the means by which a dining facility monitors: its daily cost to feed one person; its month-to-date cost to feed one person; and the ratio of its month-to-date inventory balance to its month-to-date monetary credits. The dining facility must take corrective action under the following conditions: if the BDFA is exceeded; if the cost to feed one person is 5% below the BDFA; or if the current month's authorized inventory is 20% of total monetary credits earned by the installation for the month, as reported on the SOAR.

The Financial Status of Dining Facility function is the means by which the Food Service Office monitors, on a daily basis, the financial status of the consolidated food service system and each dining facility within the system. The status for each day of the month is calculated on the "Financial Status of Dining Facility" report and is cumulative from the first day of the month. The status of a dining facility is based on the relationship between the cumulative monetary credits the facility has earned and the cumulative subsistence expenses (plus billing adjustments) it has incurred.

The Subsistence Operational Analysis function is the means by which an installation reports to Marine Corps Headquarters the status of its subsistence supply inventory, its financial status, and its cost to feed one man per day for the month. The information is reported on the SOAR, which is submitted monthly to Headquarters along with supporting documents as listed in Chapter 2 of the Food Service and Subsistence Management Manual.

Flight Meals are those meals served aboard military aircraft to crew members and to authorized military and civilian passengers. Accounting for flight meals (monetary credits and subsistence expenses) is maintained and reported separately because the meals are funded by a special allowance. Flight meal expenses and monetary credits are reported on the SOAR report and a monthly "Flight Meal Certificate" form is prepared for submission with the SOAR. The form shows the number of meals, unit cost, and total cost for each type of meal. It also shows the number of SIK meals for each type issued to the Marine Corps, Navy, and Air Force, and the total cost of food items used in the preparation of flight meals. The "Paid Supernumerary Ration Register" is used to record flight meals sold on a cash basis. The Food Service Office maintains a daily record of flight meals issued and sold. Funds received from the sale of flight meals are reported as a separate line item on the monthly "Cash Collection Voucher", which is submitted with the SOAR.

The purpose of the Dining Facility Information function is to report to Marine Corps Headquarters, on a quarterly basis, information about an installation's dining facilities. It is used, for example, to report the number of dining facility personnel, feeding capacity, and current attendance.

The "Voucher for Transfers Between Appropriation and/or Funds" is a billing document that is used to collect money from organizations whose personnel have eaten in Marine Corps Dining facilities at government expense (reimbursable SIK). Separate "Meal Signature Records" are used for each type of reimbursable SIK (Army, Air Force, Coast Guard, etc.). The number of meals for each type is a separate entry on the "Man-Days Fed Report". The number of meals for each type of meal shown on the voucher also comes from the "Man-Days Fed Report".

Cash Management. Cash management refers to the collection and disposition of dining facility funds accumulated from the sale of meals. At least once a day, or whenever the amount exceeds $100, the dining facility cashier turns in cash collected from the sale of meals to the authorized custodian of the dining facility unit and receives a receipt. Before the custodian's funds exceed $500 (or greater, if authorized by the installation commander), he or she turns them into the activity collection agent in the Food Service Office who provides receipts for the money by signing the "Paid Supernumerary Ration Registers". The activity collection agent turns in funds to the installation's disbursing office as directed by local regulations and receives a receipt. At the end of an installation's accounting cycle, the Food Service Office prepares a "Cash Collection Voucher" that shows the money turned into the disbursing office from the sale of meals for the reporting period shown on the voucher, as well as the serial numbers of the "Paid Supernumerary Registers".

System Hardware

General. Provided in Table 1 is the list and cost of equipment purchased in support of MCAFSOS. Equipment was selected to minimize cost and achieve compatibility with existing MC ADP hardware and uniform training and maintenance. Example equipment configurations are given in Figures 4 through 7 (actual equipment configurations varied).

Food Service Office (FSO). As shown in Figure 4, equipment in the FSO included a 4956 Model B Series/1 minicomputer, a 4973 line printer (system printer), a 4975 remote printer (system log), two full screen terminals (HDS Concept AVT+), two remote printers (each slaved to a terminal), line drivers, and two point of sales (POS) terminals (Control Module Model 1500 Data Entry Terminals). Each POS terminal requires 115/24V AC transformers and uses a RS422 communications line to enable data transmissions up to 5000 feet. An adapter is required to convert the RS422 to RS232 at the line driver. Pin connections for interfacing cables are shown in Figure 8. The Series/1 is a 16 bit 512KB processor with a floating point feature, 64MB fixed disk, and 2 diskette drives. The hardware and software configurations are given in Figure 9. Possible operating schemata for the six 64KB partitions are given in Tables 2 and 3. Salient terminal requirements are given in Figure 10. To enable use of the Yale ASCII Terminal Communication Package (see System Software section in this chapter) terminals must emulate a Digital Equipment Corporation (DEC) VT100. Further, terminal commands must be executable from the Series/1 without operator intervention, and up to 217 characters per line must be executable from the Series/1.

Dining Facility. Equipment included a full screen terminal (HDS Concept AVT+), a remote printer slaved to the terminal, and a line driver (9600 baud Messhall 200, 4800 baud Messhall 5000, and 1200 baud Messhall 2109).

Statistical Multiplexers. The feasibility of using statistical multiplexers (MUX) was tested by timing data transmissions between the Series/1 and 3101 terminals. One thousand consecutive 80-character lines of data were sent from the Series/1 to either one 3101 terminal or to two terminals simultaneously, with and without MUX and at either 2400 or 9600 baud rates. Using this design, time degradations, due to factors other than the use of MUX, could be detected. Data transmissions were timed using the Series/1. Communication times are given in Table 4 and time degradations are given in Table 5. As a worst case, time degradation due to multiplexing (time for two terminals with MUX minus time for one terminal with MUX) was .154 sec per 80-character line at 2400 baud and .148 sec per line at 9600 baud. No differences or negligible differences occurred when time transmissions without using a MUX were compared with those for one terminal with a MUX.

These results indicate that up to 3.7 seconds could be lost per screen of data (24 lines x .154). When these results are added to the time required to access the disk and to the time required to retrieve or store data in various files, they suggest that multiple phone lines could be a more efficient communication link between the Food Service Office and dining halls than the MUX. As a consequence, equipment configurations did not include MUX to ensure the fastest possible data transmission. Whether the use of a 9600-baud MUX would actually interfere with messhall operations needs to be tested.

TABLE 1. System Costs.

I. Hardware Description		Unit Cost	Qty	Total Cost	Monthly Maint
IBM Series/1					
Processor 256K, Unit 4956, Model	B00	8914.00	1	8914.00	37.00
Floating Point, "	3925	393.00	1	393.00	2.00
Progr's Console, "	5655	516.00	1	516.00	3.00
Add Memory 256K, "	6330	1575.00	1	1575.00	10.00
Comm Ind Panel, "	2000	197.00	1	197.00	3.00
Multifunc Attach, "	1310	1512.00	1	1512.00	9.00
Prog 8-line Ctrl, "	2095	819.00	1	819.00	7.00
Prog 4-line Adapt, "	2096	932.00	2	1864.00	40.00
Async Local Cbl, "	2056	35.00	1	35.00	1.00
EIA Dataset Cbl, "	2057	54.00	5	270.00	5.00
Disk Subsys Attach, "	3590	1209.00	1	1209.00	4.00
Diskette Adapter, "	3581	551.00	2	1102.00	12.00
Line Print Attach, "	5630	708.00	1	708.00	5.00
Rack Mounting, "	4540	42.00	1	42.00	NC
Prog 8-line Ctrl, "	2095	806.00	1	806.00	7.00
Prog 4-line Adaptr, "	2096	759.00	1	759.00	20.00
Primary Disk, Unit 4963, "	64A	8404.00	1	8404.00	51.00
Diskette Unit, " 4964, "	001	1893.00	2	3786.00	34.00
Line Printer, " 4973, "	002	9393.00	1	9393.00	143.00
Attach Cable Inc, "	5700	117.00	1	117.00	NC
Display Terminal, " 3101, "	230	1320.00	3	3960.00	55.00
Printer Remote, " 4975, "	02R	2630.00	3	7890.00	130.00
Rack Enclosure, " 4997, "	02A	951.00	1	951.00	5.00
		TOTAL HARDWARE		$55222.00	$466.00

II. Software Description	Unit Cost	Qty	Total Cost	Monthly Maint
IBM Software	9649.00	1	9649.00	N/A
Yale ASCII	3110.00	1	3110.00	N/A
BTAS	4000.00	1	4000.00	N/A
	TOTAL SOFTWARE		$16759.00	

TABLE 1. System Costs (cont'd).

III. Communication Equipment	Unit Cost	Qty	Total Cost	Monthly Maint
Data Entry (Point of Sales) Terminal, Control Module Model 1500 (1191A)*				
Basic Unit Transducer for Tone 32-Character Alpha/Numeric Display 30K Bytes Ram Battery Keypad, Numeric w/28 Function Keys Time of Day Clock	1875.00	2	3750.00	--
Badge Reader (Feature 1923)	244.00	2	488.00	--
CLA w/Bell Transformer (Feature 1318)	207.00	2	414.00	--
Cable	NC	N/A	NC	--
Adapter	?	5	?	--
Mylar Overlay (Three Colors)	N/A	N/A	900.00	--
TOTAL COMMUNICATION EQUIPMENT			$5552.00	None

IV. Work Station Equipment	Unit Cost	Qty	Total Cost	Monthly Maint
Display Terminal, HDS Concept AVT	890.00	6	5340.00	None
Printer, TI Model 860 XL	725.00	6	4350.00	"
Paper - Catch Basket	25.00	6	150.00	N/A
Line Driver	149.00	12	1788.00	N/A
Multiplexer, 2 Port	695.00	2	1390.00	None
Modem	495.00	2	990.00	"
Uninterruptible Power Supply (1000 VA)	1140.00	1	1140.00	"
Uninterruptible Power Supply (400 VA)	750.00	2	1500.00	"
Std Low Energy Encoder	3700.00	1	3700.00	"
Card Cutter	250.00	1	250.00	N/A
Identification Cards w/Art Work	N/A	N/A	1311.00	N/A
TOTAL WORK STATION EQUIPMENT			$21909.00	
GRAND SYSTEM TOTAL			$99908.00	

*A 1-year mail-in warranty is provided from date of purchase covering parts and labor. Maintenance costs after the warranty period are based on actual required repair of units.

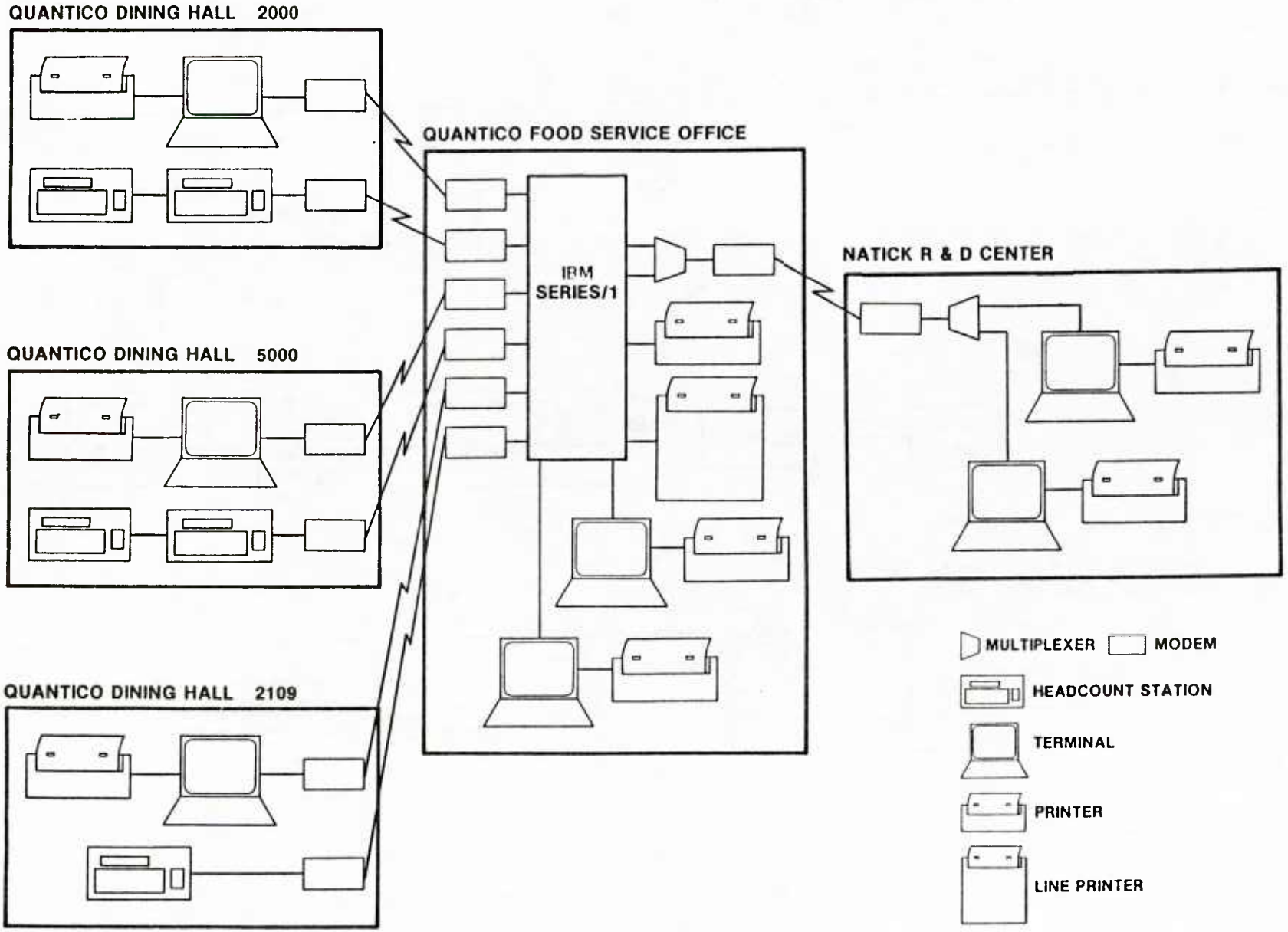


Figure 4. Hardware configuration.

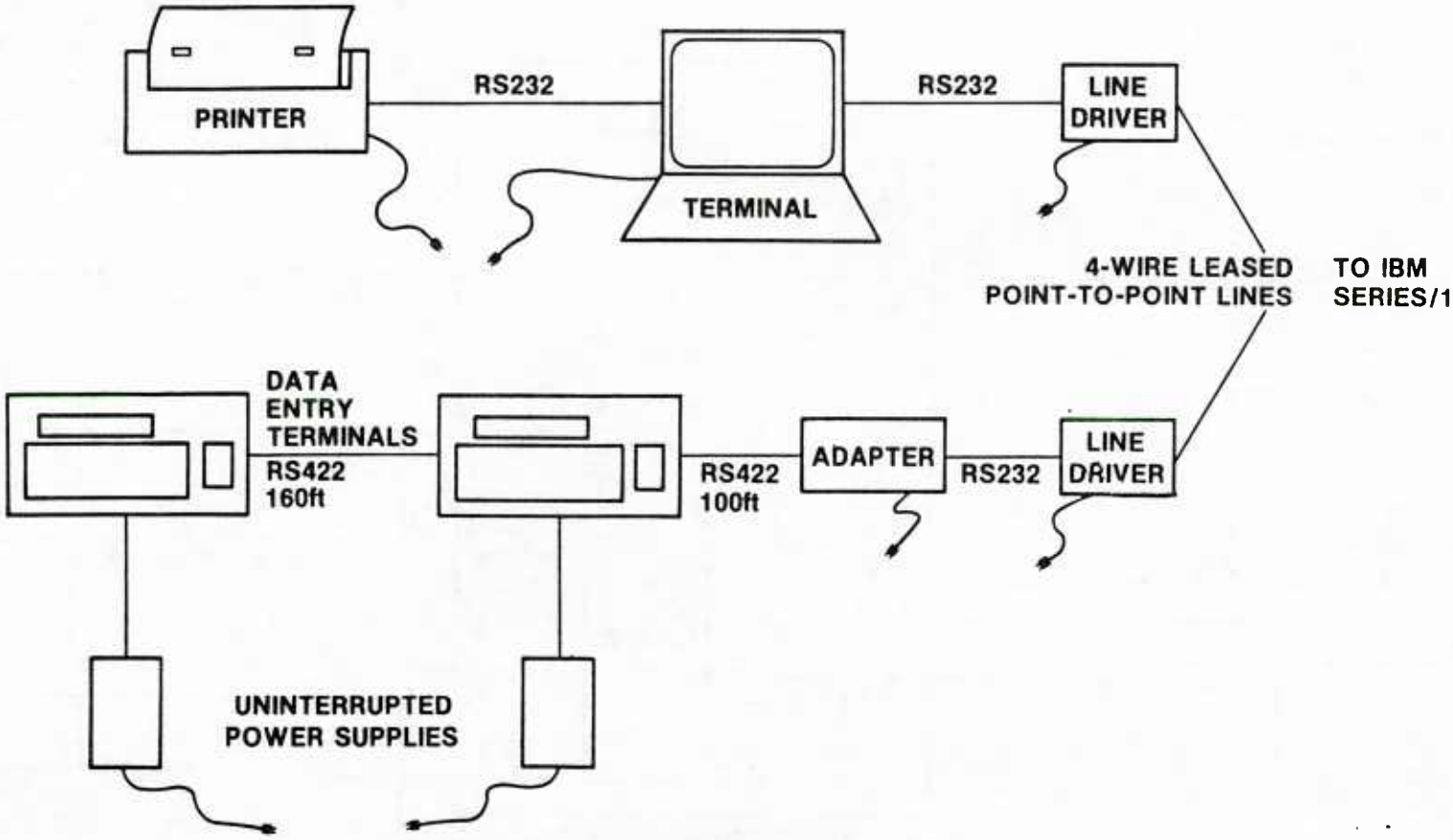


Figure 5. Hardware configuration of messhall 2000, Bruce Hall.

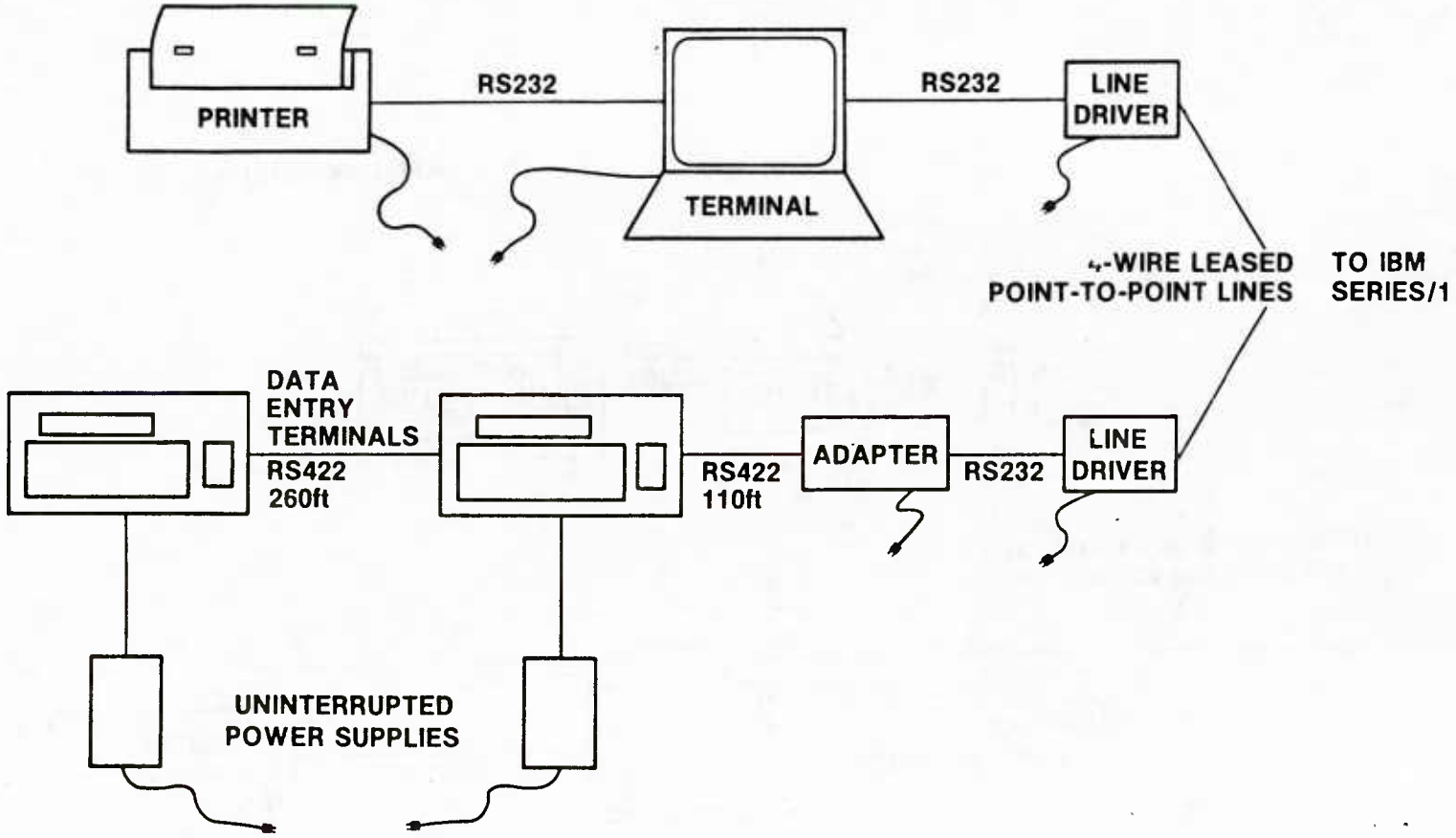


Figure 6. Hardware configuration of messhall 5000, Bobo Hall.

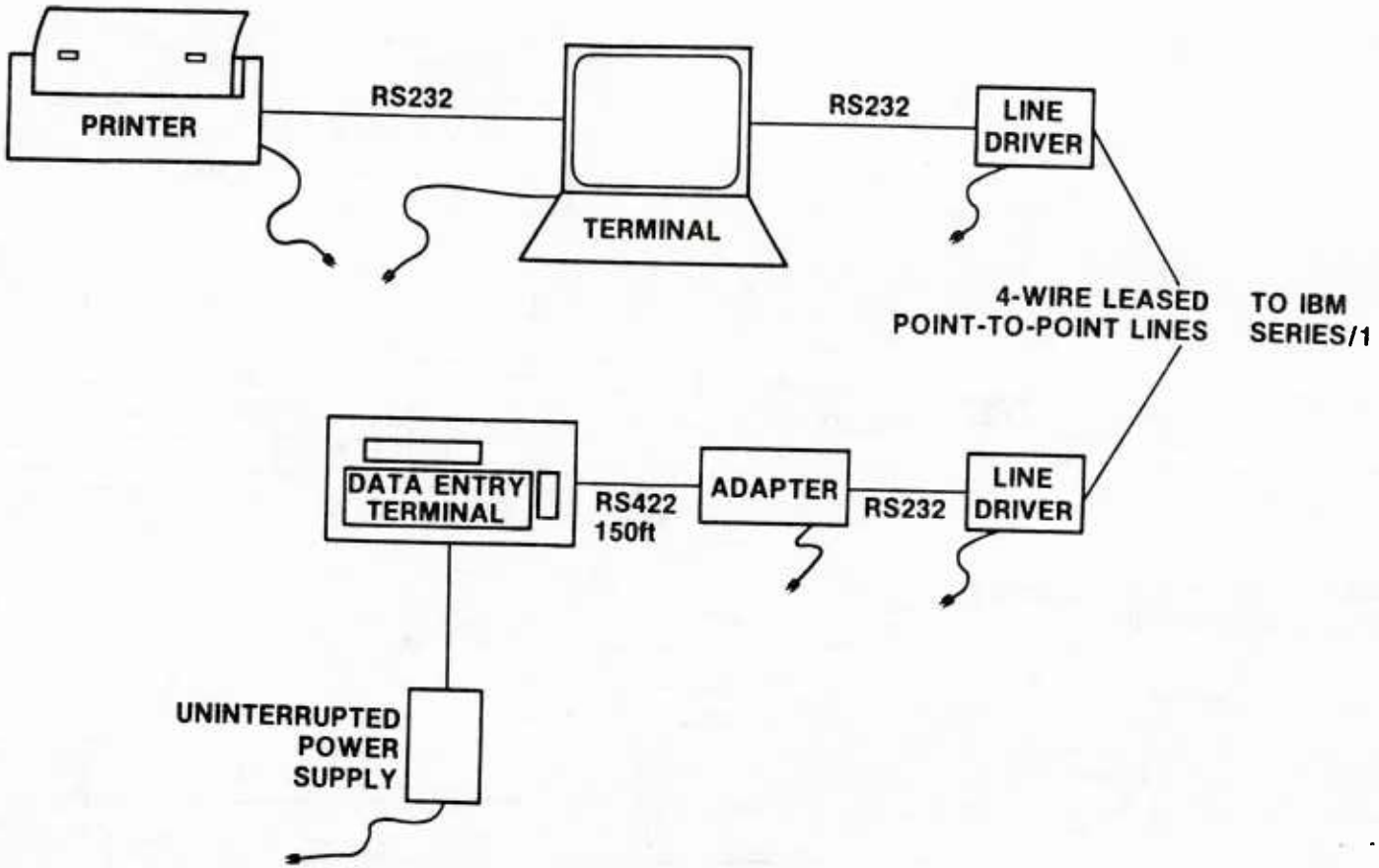
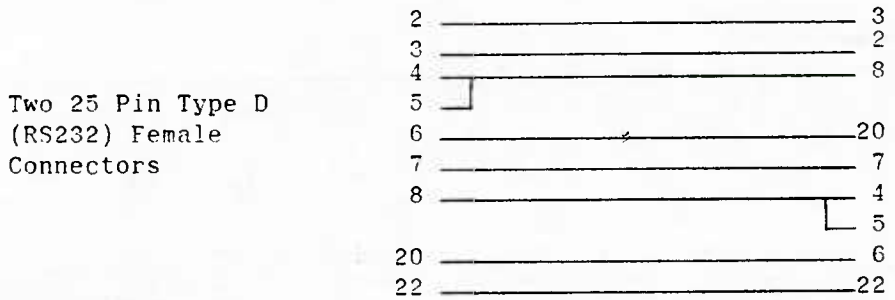
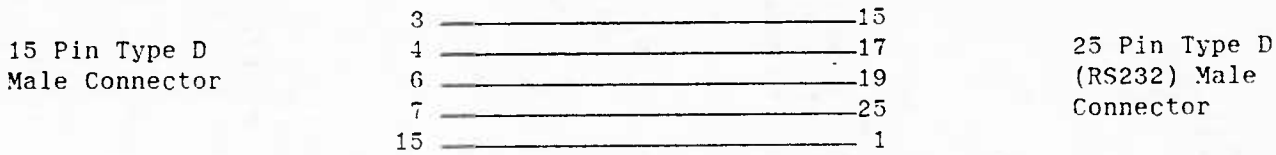


Figure 7. Hardware configuration of messhall 2109, Air Facility.

I/F (null-modem) Cable Between IBM Series 1 and Full Screen Terminal



I/F Cable for Multidropping Two or More Badge Readers



I/F Cable Between Badge Reader and 422/232 Converter

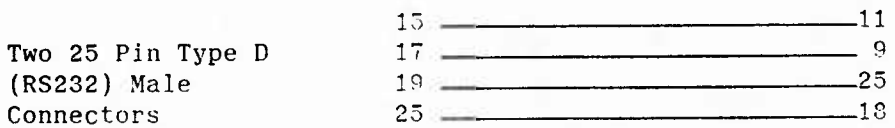


Figure 8. Configuration of interfacing cables.

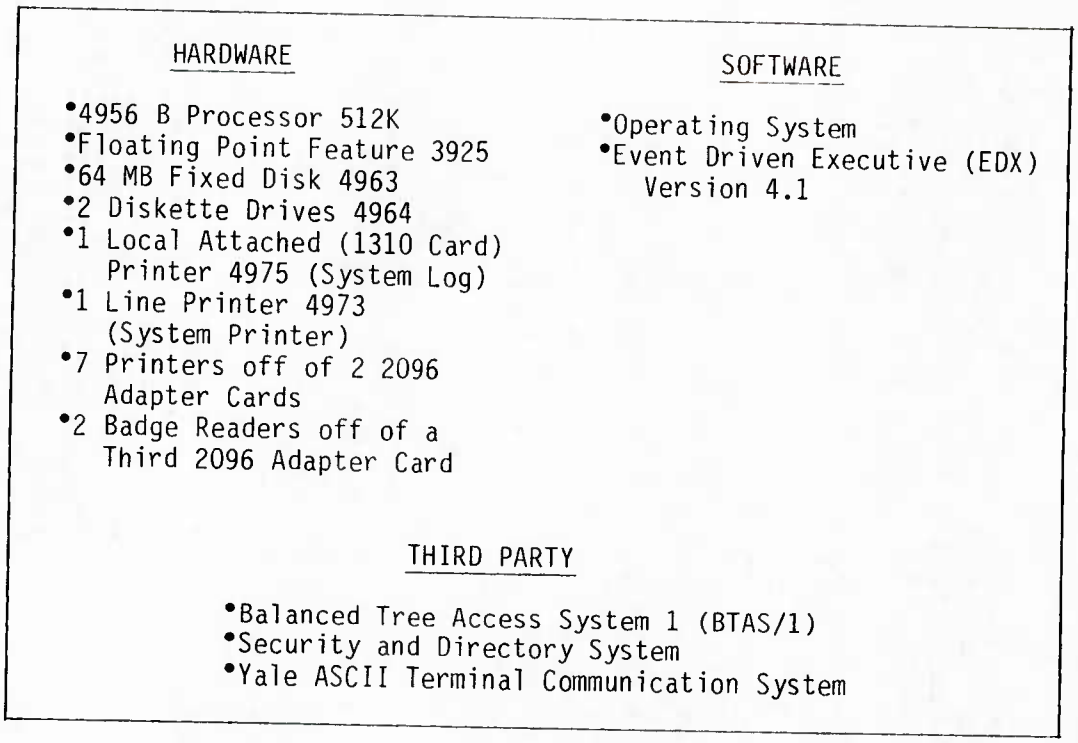


Figure 9. Hardware and software configuration.

TABLE 2. Estimated Kilobytes RAM Used in Each of Eight 64KB Partitions: Actual Configuration.*

PARTITION	SYSTEM	KB
1	Supervisor	39
	#Waiter	1
	SPCCBS	1
2	Yale ASCII	30
	BTAS 1	20
	Error Logger	8
3	Terminal 1 (FSO)	64
4	Terminal 2 (FSO)	64
5	Terminal 3 (5000)	32
	Terminal 4 (2000)	32
6	Terminal 5 (Natick)	64
7	Terminal 6 (Natick)	64
8	Supervisor	18
	Spooler	12
	Terminal 7 (2109)	34

* A printer functions as the system log.

TABLE 3. Estimated Kilobytes RAM Used in Each of Eight 64KB Partitions: Possible Operational Configuration.*

PARTITION	SYSTEM	KB
1	Supervisor	39
	# Waiter	1
	SPLCCBS	1
2	Yale ASCII	28
	BTAS/1	16
3	Up to 32 POS Term	64
4	Up to 4 Full Scr Term	64
5	Up to 4 Full Scr Term	64
6	Up to 4 Full Scr Term	64
7	Up to 4 Full Scr Term	64
8	Supervisor	18
	Spooler	12
	Error Logger	8

*A printer functions as the system log.

- Emulate VT100	- 24 Lines x 80 or 132 Characters
- Four Pages Memory	- Two Full Duplex Async RS232 Ports (9600 Baud)
- Terminal Commands Exe From Series/1 Without Oper Intervention	- 217 Char per Line Exe From Series/1

Figure 10. Required terminal features.

TABLE 4. Communication Times in Seconds for 1000 Consecutive 80-Character Lines of Code Sent From the Series/1 to Either One or Two Terminals With and Without MUX.

		Baud Rate	
		2400 Baud	9600 Baud
One Terminal(no MUX)	Terminal 1	337	61
Two Terminals (no MUX)	Terminal 1	317	62
	Terminal 2	317	62
One Terminal (with MUX)	Terminal 1	337	62
Two Terminals (with MUX)	Terminal 1	410	209
	Terminal 2	491	209

TABLE 5. Degradation in Seconds for Each of Two Terminals per 80-Character Line of Code Due to Statistical Multiplexer Using Communication Times for One Terminal With MUX as Baseline.

	2400 Baud	9600 Baud
Terminal 1	.073	.148
Terminal 2	.154	.148

System Software

System operating software included Event Driven Executive (EDX) version 4.1 operating system, balanced Tree Access System 1 (BTAS/1), Security and Directory System, and the Yale ASCII Terminal Communication System. The EDX operating system is a multiuser system developed exclusively for the Series/1. The BTAS/1 file management system and the Security and Directory System, developed for the Series/1, are propriatory software packages that were selected to maximize system response time and minimize overhead requirements. The BTAS/1 file management system is twice as fast as the IBM Index Access Method (IAM) and requires half the random access memory (RAM) overhead (BTAS/1 requires 7KB for code plus a 7KB to 9KB buffer; IBM requires 32KB minimum). BTAS/1 requires no file sizing and consequently uses half the space on disk for dynamic files compared to IBM (unless files are compressed).

The Security and Directory System prevents unauthorized access to application programs and provides/integrates menus application programs. It also provides a "window environment" and subprogramming through a shell program that allows programs to call programs, pass parameters, and return like a subroutine. Because of these system characteristics, terminals accessing the Series/1 require relatively small areas of partition RAM, and one Series/1 is capable of supporting up to 16 dining facilities. The system is eight times faster than the IBM Multiple Terminal Manager (MTM) overlay method (due to a performance limitation the MTM, at 2400 baud rate, permits the support of only eight dining halls). The MTM also requires excessive overhead, which restricts the amount of code that can be located with it.

The IBM Yale ASCII Terminal Communication System, developed exclusively for the Series/1, is required for the Security and Directory System. It allows the use of a wide range of terminals and creates a faster, friendlier system for developers and users. Further, the package is cost-effective. The IBM 3101 block mode terminal can be replaced at approximately half of its cost and the IBM 4978 can be replaced at one-fourth of its cost (with attachment cards). Yale ASCII, however, requires more Computer Processing Unit (CPU) cycles than IBM terminals and requires more RAM than IBM terminals.

The MCAFSOS was undertaken with COBOL as the application language. COBOL, however, was designed for batch processing and not an interactive management information system. COBOL programs are relatively large (average size 32KB) and

require more than half of a partition, thus limiting the Series/1 to one or two terminals per partition (10 terminal maximum). As a result of these limitations, Event Driven Language (EDL) was selected. Event Driven Language is native to the Series/1, compatible with Marine Corps ADP equipment, and requires much less overhead than COBOL. Further, it permitted the use of the BTAS/1 file system.

AUTOMATED SYSTEM DESIGN

The system design has been outlined in whole, or in part, in data flow charts and file specifications. An overview is given in Figure 11.

Reports

The following reports were coded:

Cook's Worksheet NAVMC 36
Product Sheet NAVMC 10616
Cook's Produce Requirement Sheet NAVMC 10615
Subsistence Issue Receipt NAVMC 10568
Armed Forces Recipe Service MCO P10110.16C, Rev
Master Menu of Calendar Year
Man-Days Fed Report NAVMC 565-1
Financial Status of Dining Facility NAVMC 584
Food Cost Analysis
Computation of Basic Daily Food Allowance NAVMC 580
Subsistence Operational Analysis NAVMC 10369
Flight Meal Certificate
Stock Record and Inventory Control Card NAVMC 708
Inventory Requisition and Issue NAVMC 10815-10819, 10941
Certificate of Survey

The following reports were not coded, though in several cases the procedures were automated. There were specific programs, for example, to handle transfers, turn-ins, and price adjustments.

Meal Signature Record NAVMC 10789
Paid Supernumerary Ration Register NAVMC 10298
Cash Collection Voucher DD1131
Purchase Orders (to local vendors for bread and milk)
Unsatisfactory Material Report
Certificate of Transfers and Sales
Items Constituting Price Adjustments
Certificate of Issues for Turn-In
Certificate of Price Adjustments
Certificate of Loss or Gain
Certificate of Credit ot Sales
Certificate of Deficit Operation
Certificate of Dining Facility Information
Flight Meal Request, Issue and Receipt Form (made by unit)
Voucher for Transfer between Appropriations and/or Funds
SF 1080 (DSSC function)

Application Software

The automated system existed in over 60 programs coded in EDL, an application software language that is unique to the operating system of the Series/1 minicomputer. Programs are listed by modules in Table 6. Users gained access to application programs through a hierarchical system directory. The initial directory provided a "menu" of the modules into which the programs were grouped and prompted

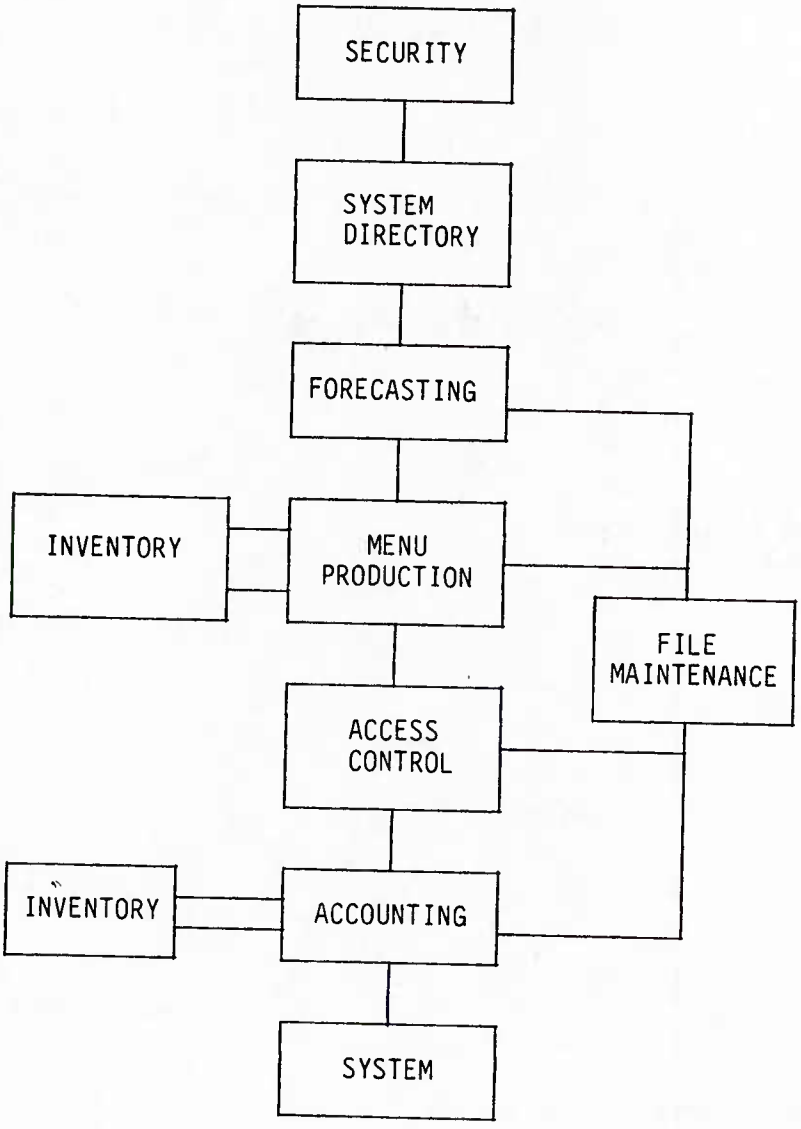


Figure 11. System operational overview.

the user to select the module containing the programs the user was authorized to use. Once the module was selected, the user was presented with a listing of programs from which programs were selected for use. Upon the completion of one program, the user was returned to the program directory. All programs were "user friendly" in that they provided prompts to guide the unsophisticated user through the program to a successful completion. Programs were designed to automatically access, update, and retrieve data from the system files as required in report preparation and audit trails. Programs also featured common exits, common messages, and common formats.

TABLE 6. Application Programs by Module.

FORECASTING MODULE

Description	Program Name
Calendar File Generator	#CALGEN
Calendar File Updater	#UPCAL
Headcount Forecast File Updater	#UPHEAD
Headcount Forecaster	#HEADCNT

MENU PRODUCTION MODULE

Description	Program Name
Master Menu Lister	#MENLIST
Menu File Updater	#UPMENU
Postmeal Cook's Worksheet	#POSTWRK
Postmeal Subsistence Issue Receipt	#POSTSIR
Premeal Cook's Worksheet	#COOKWRK
Premeal Subsistence Issue Receipt	#PRESIR
Produce Requirements Sheet	#PRODUCE
Product Sheets	#P.SHEET
Recipe File Lister	#RECLIST
Recipe File Updater	#UPREC
Preflight Meal Breakout	#PREFLY
Postflight Meal Breakout	#POSTFLY

ACCOUNTING MODULE

Description	Program Name
Computation of the BDFA	#BDFA
Consolidated Financial Status of DF	#CFSTAT
Consolidated Man-Days Fed Report	#MMDFR
Financial Status of Dining Facility	#FINSTAT
Flight Meal Certificate	#CERTFL
Food Cost Analysis	#FCAREP
Man-Days Fed Report	#FEDRPT
Subsistence Operational Analysis Report (SOAR)	#SOA.REP

ACCESS CONTROL MODULE

Description	Program Name
Communications Program	#COMMUN
Exception Report for Meals	#XMLSTAT
Master SIK File Lister	#MSIKLIS
Master SIK File Updater	#UPMSIK
Post Meal-Time Processing	#POSTACC
Start Meal Processing	#MLSTART
Stop Meal Processing	#MLSTOP
Valid SIK File Lister	#VSIKLIS
Valid SIK File Updater	#UPVSIK
Validation Program	#VALIDATE
POS Initialization Program	#DOWNLD
Revenue Report	?

TABLE 6. Application Programs by Module (cont'd).

SYSTEM MODULE

Description	Program Name
Report Retrieval	#DESPOOL

FSO FUNCTIONS MODULE

Description	Program Name
Audit Lister	?
User Editor	#MSURED
Backup Data Base	#BTSAVE
Restore Data Base	#BTREST

FILE MAINTENANCE MODULE

Description	Program Name
Base Data File Updater	#UPBASE
BDFA File Updater	#UPBDFA
Branch code File Updater	#BRANCH
Cash Sales File Updater	#UPCASH
Cost and Surcharges File Updater	#UPCOST
Daily Monetary Issues File Updater	#UPDMIT
Delivery and Consumption File Updater	#UPDELIV
Dining Facility Information File Updater	#UPDFIN
Dining Facility Inventory File Updater	#UPDFINV
Expenditures File Updater	#UPEXP
Flight Meals Issued File Updater	#FLMEALS
Headcount Branch File Updater	#UPBRNCH
Inventory Balance File Updater	#UPINVBL
Man-Days Fed File Updater	#FEDUPDA
Monetary Transfers File Updater	#UPMONEY
Monthly Headcount File Updater	#UPMONT
Other Sales File Updater	#UPOTHER
Paid Supernumeraries File Updater	#UPSUPER

INVENTORY MODULE

Description	Program Name
Mess Hall Requisitioning	#DHREQ
Fixed Price Updater	#UPFIXPR
Food Item Information File Lister	#FILIST2
Food Item Information File Updater	#UPFITEM
FSO Forecast of Subsistence	#FSOREQ
Inventory Lister	#INVLIST
Inventory/Survey Approval	#ISAPP
Monthly Inventory	#MNTHINV
Monthly Inventory Reconciliation	#RECON
Receiving	#RECVING
Stock Record and Control Card	#STOCK
Surveys (Mess Hall)	#SURVEYS
Transfers	#TRANS
Turn-Ins	#RETURNS
FSO Monthly Survey Certificate	#FSOSURV

Security and Directory System (Mail). The Security and Directory System, coded out of house, controlled access to system software, provided user guidance, and provided a mail system. The security system provided controlled access by requiring the terminal operator to enter an identification number and password in order to use the computer. Individuals were permitted access to certain modules and to certain programs within modules as required by their positions. At least one individual, for example, the Food Service Officer, had access to all programs, had edit privileges for existing users, and assigned privileges to new users. When an individual gained access to the system, the directories aided the user by providing lists of user options and prompts that guided the individual to the programs he or she were able to run. The mail system enabled users to write, send, receive, read, and file messages.

Forecasting. The Forecasting Module provided the user with a tool for predicting headcount for a specific meal and dining facility. The routine used different equations for each meal and dining facility. Equations were developed from multiple regression analyses based on 12 months of Marine Corps headcount data. The module required the user to enter expected Reserve Officers Training Corps (ROTC) attendance. Predictor variables included days since pay, holidays, month, ROTC attendance, and average attendance (average messhall attendance over all meals over 3 years). ROTC attendance and transient effects due to unanticipated arrivals or departures of individuals requiring government messing were accounted for by manually adjusting the forecast by entering data into the module. The Forecasting Module has to be executed prior to the Cook's Worksheet Program contained in the Menu Production Module. This program automatically retrieves the predicted headcount from the Forecasting Module and used it to determine quantities of food to prepare for a meal. The module consisted of a headcount forecaster, a calendar, and programs to adjust (update) the headcount forecast and calendar.

Menu Production. The Menu Production Module provided cooks with most of the information necessary for the preparation of a specific meal. The module used a cyclic master menu changed daily at noon and supper meals, and provided a forecast of the number of required portions, the specific recipe ingredients required, recipe ingredient quantities required for the forecasted number of servings, the exact quantities of the ingredients to be drawn from the stockroom, and the method of preparation. The module contained 10 programs.

The Cook's Worksheet, for example, was generated before and after the meal. The Premeal Worksheet provided the senior cook with a complete list of all menu items to prepare and the required number of portions of each item. The number of portions to prepare was based on the predicted headcounts and the relative frequency with which the item had been selected by customers in past meals:

NO. OF PORTIONS = HEADCOUNT FORECAST x ACCEPTABILITY FACTOR

The Postmeal Worksheet allowed the senior cook to enter the portions served and instructions on any leftovers. The Postmeal Worksheet also calculated the acceptability factor:

$$\text{ACCEPTABILITY FACTOR} = (1.0\ (X_1) + .50\ (X_2) + .25\ (X_3))/1.75$$

X_1 = SELECTION RATIO FOR THE MOST RECENT MEAL HAVING THE FOOD ITEM
X_2 = SELECTION RATIO FOR THE NEXT MOST RECENT MEAL
X_3 = SELECTION RATIO FOR THE THIRD MOST RECENT MEAL

$$\text{SELECTION RATIO} = \text{NO. PORTIONS SERVED/NO. ATTENDED}$$

Like the Cook's Worksheet, the Subsistence Issue Receipt Form was generated before and after meals. The preform listed the quantity and cost of each food item to be broken out of the stockroom for each meal; the postform updated the pre-daily form by including the actual quantity issued and returned and any supplementary items that may have been added to the menu and used. A Produce Sheet routine indicated the fresh produce required for a meal. The Product Sheet routine converted the standard recipe quantities (amounts required for 100 portions) to the quantities required for the actual number of portions to be prepared:

$$\text{CONVERSION FACTOR} = \text{BATCH YIELD/100}$$

The batch yield was entered manually and depended on the available equipment, number of messhall personnel, and the required number of portions.

A Master Menu Lister, a Recipe File Lister, a Menu File Updater, and a Recipe File Updater were also provided in this module.

Inventory. The Inventory Module provided a means of recording subsistence issues and receipts and determining quantities of items on hand. The module contained 15 programs. The Stock Record and Inventory Control Card Routine, for example, provided an inventory of one food item for up to 30 days and included receipts, issues, transfers, surveys and inventory adjustment data. The Inventory Lister Routine was used to generate a listing of the food items in the inventory and was used to record a count of the actual physical level of each item. The Monthly Inventory Routine provided a discrepancy report that listed the accountable balance, the "available for issue", and the reported physical level. It was used for a recount of items for which there was a reported discrepancy. The Reconciliation Routine printed a second discrepancy report and adjusted the "available for issue" of each item in the inventory for which there actually was a discrepancy. When the discrepancy report was signed by the Food Service Officer, an Inventory/Survey Approval Routine was executed in which the accountable balance was adjusted and an audit trail of the reconciliation was created. A Survey Routine was run when food items that were unfit for human consumption were discovered. This routine printed a Certificate of Survey containing food item data--NSN, quantity of food, reason for survey (spoiled, damaged, etc.) value of food, etc.--and adjusted the amount "available for issue". The Inventory/Survey Approval routine was run to update the accountable balance when the Certificate of Survey was signed by the FSO. Other programs recorded food items that the stockroom received from DSSC or vendors (Receiving), provided food item information such as unit cost, nomenclature, and package mode (Food Item Information Lister), enabled price updates (Fixed Price Updates), provided for turn-ins (Turn-Ins) and recorded transfers from another dining facility or to another facility (Transfers). Dining hall requisitioning and Food Service Office requisitioning were also functions of this module. Dining facility level subsistence requests were projected short-range requirements for

specific consumption periods and were produced for use by the Food Service Office. They were based on the menu and recipes, usage factors (pounds/volume based on 100 portions required on an average day), what was on hand, what was on order, and what would have been received on time:

(LB/VOLUME PER 100 REQUIRED ON AVERAGE DAY)
x
(NO. OF DAYS SERVED DURING CONSUMPTION PERIOD)

= (WHAT IS ON HAND, WHAT IS ON ORDER, AND WHAT WOULD HAVE BEEN RECEIVED).

Base level subsistence requests were projected long-range requirements made for 30 to 90 days ahead of time and were produced for use by DSSC. They were based on the Master Menu and recipes, pounds per 100 individuals per meal for each recipe ingredient for 30 days for each item, feed factors (man-days fed for that month of the previous year), and acceptability factors:

(LB PER 100 INDIVIDUALS)
x
(NO. OF MEALS INGREDIENT USED)
x
(ACCEPTABILITY FACTOR)
x
(FEED FACTOR/100)

The two requisitioning routines, however, were not successfully tested.

Access Control. This module was designed to provide real time physical access control to dining facilities by using magnetic stripe card readers that were electronically linked with the host computer (see Access Control/Automated Headcount section in this chapter). The procedure required all credit customers to pass a magnetic stripe meal card through the reader that captured data off the magnetic stripe and sent it to the host computer for multiple validation checks. These checks included ID card number, card issue number, branch of service, and whether the card holder had already received a meal during the meal period. An authorization signal was given if the card was valid while an infraction message was given if the card was invalid. The module, however, allowed for credit customers without valid cards. Entitlement was established by validating manually keyed in customer data. It also allowed for cash customers and provided total sales by cash customer type (COMRAT, child, etc).

The module consisted of 12 programs (see Figure 12). The POS Initialization Routine defined the POS terminal's files and function keys. The Validation Routine accomplished the validating of meal cards through checking data stored in the Master SIK and Valid SIK Files, generated infraction messages, and prompted for and recorded data on credit customers without valid meal cards and cash customers. The Validation Routine read from a "Preprocess" File and wrote to a "Postprocess" File. The Communication Routine (Figure 13) transferred data between the Series/1 and the card readers. It polled each card reader sequentially, identified the source of the data and checked its accuracy, and wrote the data to the Preprocess File. It read data from the Postprocess File (prompts and commands), determined the destination of the data, added protocol data, and wrote the data to the card readers.

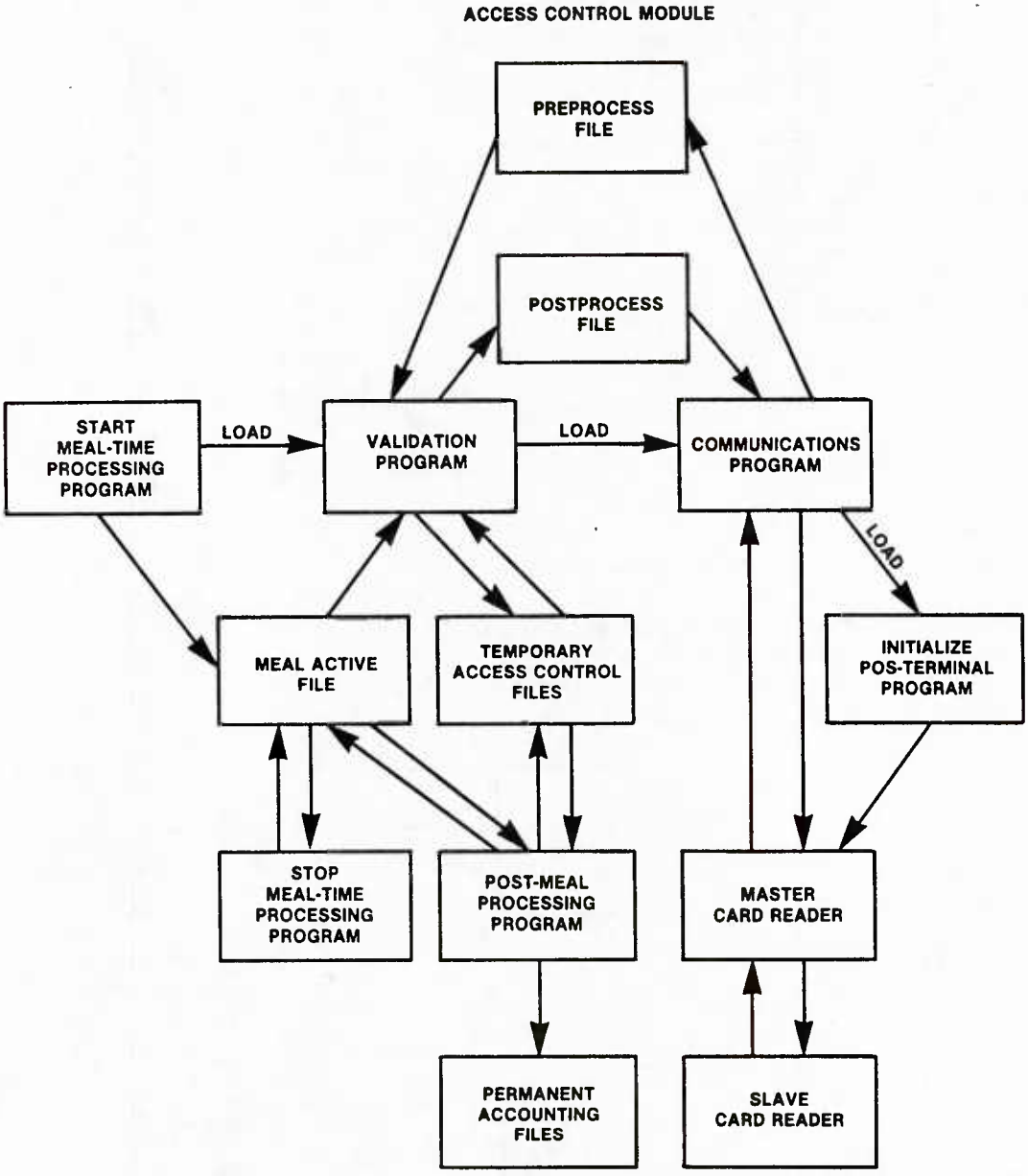


Figure 12. Interrelationship of access control programs.

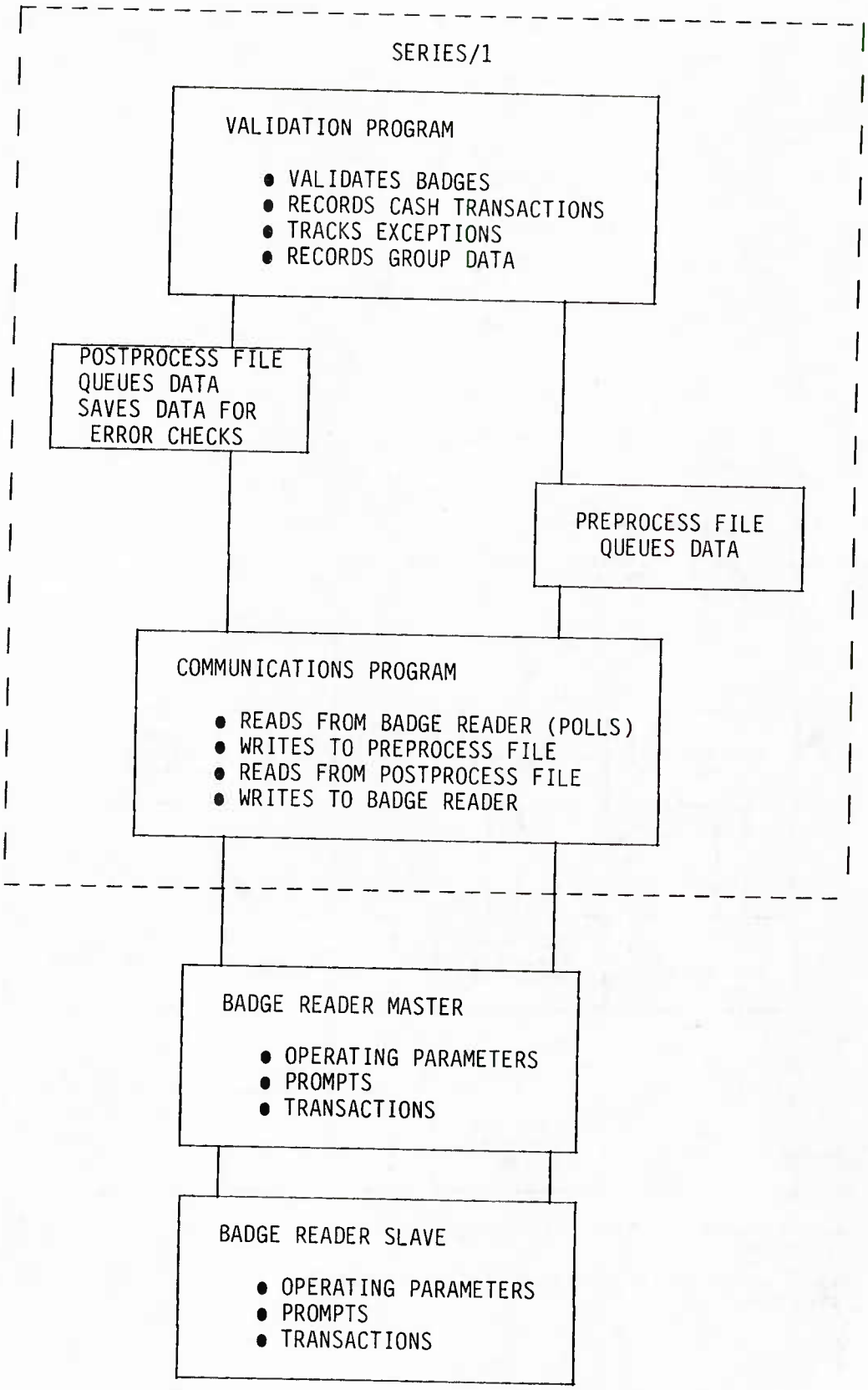


Figure 13. Interrelationship of validation program, communication program, and card readers.

The Start Meal Time Processing Routine loaded the Communication, POS Initialization, and Validation Routines and "told" the Validation Program that the meal had begun (set a flag in the meal active file). The Stop Meal Processing Program "told" the Postmeal Processing Program that the meal had ended (set a flag in the meal active file), which in turn polled each reader buffer and wrote the data to the appropriate files.

An Exceptions Report was designed to provide an audit trail of customers admitted on a credit basis without valid meal cards, and a Revenue Report was designed to provide the dollar value of cash sales by cash customer type (COMRATS, surcharge, etc.).

Use of the module would prevent illegible signatures and the reporting of incorrect meal card numbers as a means of gaining entrance to a dining facility. The module would also help prevent illegal signatures of individuals using someone else's card because meal cards were designed to have a color photograph of the individual to whom it was issued. This, however, assumes that cashiers would validate cards by checking pictures against card holders.

Accounting. While the Inventory Module provided the user with a listing of items and item quantities, the Accounting Module provided the user with the dollar value of the items including receipts, returns, issues, transfers, "available for issue", and the accountable balance. The module was designed to generate all required dining hall and installation accounting forms and used eight programs. The Food Cost Analysis Routine, for example, provided a daily monetary record of food sold, categorized by meal and food group and reflected man-days fed. The total cost of each meal was divided by the headcount to yield the cost per meal and the cost of three meals was divided by the daily man-days fed to yield the cost per man-day. The total accumulated expenditures month to date was divided by the man-days fed month to date to yield the average cost to feed one man for one day, and this cost was compared with the BDFA. Daily subsistence expenditures were subtracted from the opening inventory plus daily receipts and price adjustments to yield the current inventory value, which in turn was divided by the total monetary credit (man-days fed month to date times BDFA) to yield the percent of inventory equivalent to the montary credits. The Man-Days Fed Report routine converted headcounts to man-days fed (rations used weighted for meal value) by branch of service and paid supernumeraries for each dining facility. The Consolidated Man-Days Fed Routine calculated man-days fed using headcount figures from all dining facilities. The Financial Status of the Dining Facility Routine calculated daily monetary credits (man-days fed x BDFA), subsistence cost by food group, found the difference (reserve or over expenditure), and based on the cumulative man-days fed and inventory used, calculated the cost to feed per man. The consolidated version of this routine averaged the same accounting data over all dining facilities. The Flight Meal Certificate Routine calculated the BDFA based on the local cost of bread and milk. Finally, the SOAR routine reported the cost of food received from DSSC during the month, provided space for commissary input, consolidated base food service operation accounting data, and found the current month authorized inventory (.20 x total monetary credits).

Access Control/Automated Headcount

Card Design. The magnetic stripe plastic card that was chosen for use in the headcount module conformed to American Banking Association (ABA) Track Two

Standards and was the size of a credit card. The card holder's issue number would be encoded on the magnetic stripe and the card would display the customer's name, signature, SSN, expiration date, and a 1-inch x 1¼-inch color photograph of the customer. Customer data, initially recorded on a source data card (Figure 14), along with the color picture, would be inserted in the card and laminated with a clear plastic cover. A card control number would also be displayed.

Card Issue. The following describes a six-step procedure for issuing meal cards to a sample of permanent party personnel. As many as 50 to 100 people can be scheduled for processing in a single working day, and the issuing activity should be completed approximately 1 week before the cards are required for access to the dining facilities. The procedure for issuing meal cards involves six steps. (1) Participants are scheduled for approximately 10-minute appointments at a meal card issuing point and are required to bring their current meal cards and military identification. These documents are used to establish their entitlement to subsist at government expense. (2) Each participant's name, signature, SSN, and card expiration date are recorded on a source data card (Figure 14). The information is recorded on a section of the card that can be "punched out" and on a section that is retained as a record. (3) The individual is photographed, then the photograph and the "punch out" section with the information about the participant are inserted in the plastic card, which is laminated with a clear plastic cover. (4) The card control number, participant's name, SSN, reporting unit code, participant's signature, and other data are recorded in a log book. (5) The magnetic stripe, which is used for the real time validation of the meal card, is encoded with the participant's SSN, branch of service, and card issue number. (6) Finally, the individual's SSN, name, branch of service, and card issue number and date, card expiration date, card status (valid or missing), duty status, and unit are entered into the Master SIK File (Table 7).

POS Terminal Features and Functions. The POS terminal (Figure 15) features a magnetic stripe slot reader (conforming to the ABA standards) built-in logic (microcode), 32KB memory capable of storing 1,578 12-character transactions, time of day clock, 32-character display, 10 numeric keys, 28 function keys, and a transducer for a tone. The system automatically logs transactions should the host computer fail to respond within 10 seconds, and the system has an uninterruptible power supply (UPS) permitting operation given a main electrical power failure. The system also has an internal battery which maintains the integrity of stored data in the absence of any power. The system does not feature customer receipts and audit tapes, register front display, key lock controls, or a cash drawer with a removable till. System hardware features and costs are given in Table 1, and a listing of the numeric and function keys and their use is in Table 8. The keyboard design is given in Figure 15 and backup functions are listed in Table 9. Listed in Table 10 is the communication hardware necessary for supporting the POS terminals.

The system was capable of postmeal data transmission, as well as real time card validation, and allowed for entering and recording of cash customer types (COMRAT, child, etc.) to establish cash accountability. It also allowed for entering and recording the SSN's and service branches of credit customers without valid meal cards, as well as reasons for not having a card, to establish entitlements and accounting classifications (customers by branch of service, Table 11) for these customers. In addition, it allowed the cashier to override computer-generated infraction messages. The terminal did not permit item pricing, did not allow miscellaneous dollar amounts to be entered, and did not display a subtotal.

Source Data Card

Reporting Unit Code (RUC)

Card Issue Number: First Second Third

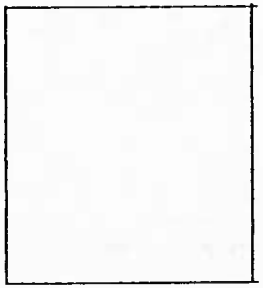
Card Disposition: Destroyed Missing

Name: Last First Middle Rank

Social Security Number Expiration Date

Service Branch Card Issue Date

Card Control Number



Name

SSN Exp Date

Signature

Marine Corps Food Mangement Information System Test

Log Book
(Example)

Control Number	Name	SSN	RUC	Signature of Card Holder	Issue No	Issue Date	Exp Date	Disposition	Recover Number	Signature of Responsible Officer

Figure 14. Magnetic stripe meal card control records.

TABLE 7. Master SIK File Description.

Master Subsistence in Kind File — 1/Base

BTAS Directory: Meal-Validation
BTAS File Name: Master-SIK
Key Length: 9
Record Length: 53
File Type: BTAS

Key Description:	
Social Security Number	9(9)[a]
Record Description:	
Branch Code	99
Active Date	X(6)[b]
Expiration Date	X(6)
Card Issue Number	XXX
Status, Card	9
Status, Duty	9
Name	X(25)
RUC	9(5)

Card Status: 0 -- Valid Card
1 -- Lost Card

Duty Status: 0 -- Present for Duty
1 -- On Leave
2 -- Hospital
3 -- TAD
4 -- Jail

[a] 9 denotes one character of numeric data; a number in parentheses indicates the number of possible numeric characters

[b] X denotes one alphanumeric character of data; a number in parentheses indicates the number of possible alphanumeric characters.

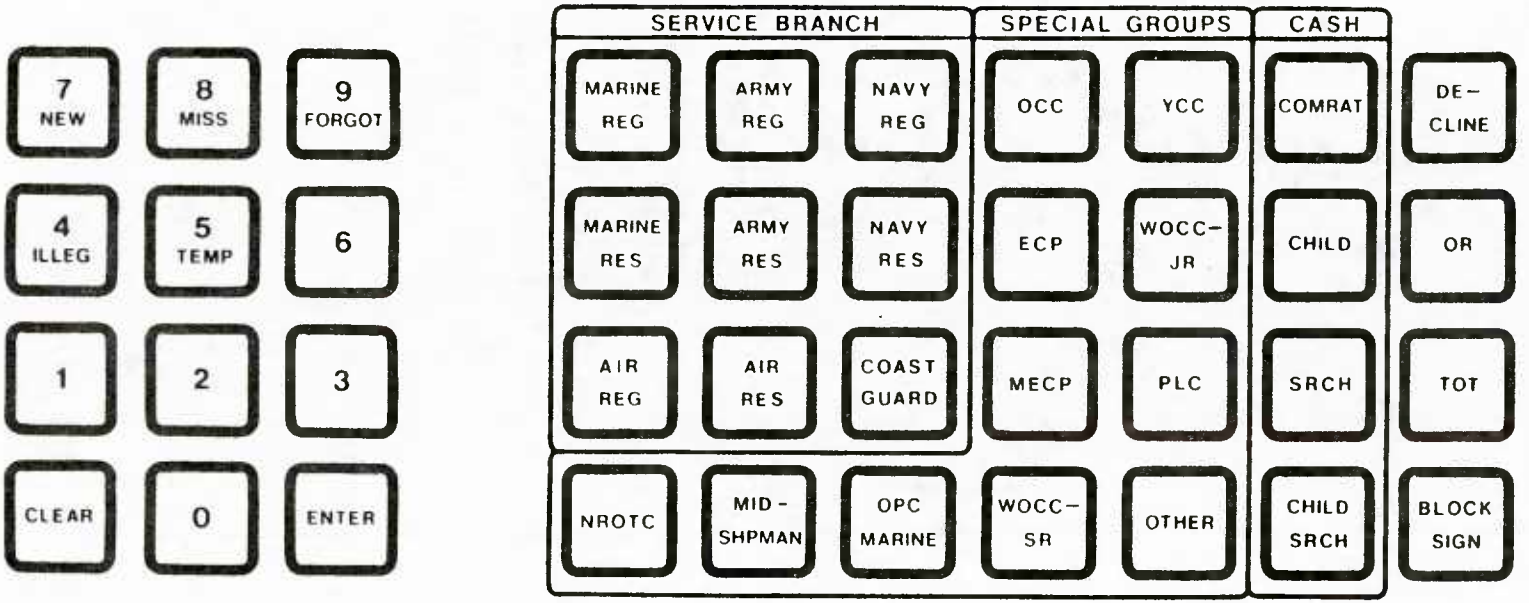


Figure 15. Point of sale (POS) terminal keypad design.

TABLE 8. POS Terminal Numeric and Function Key Use.

Terminal Key	Purpose
20 function keys, Services Branches	Record customer branch of service
COMRAT	Record meal at cost
Child	Record meal at cost for child
Srch	Record meal at cost plus surcharge
Child Srch	Record meal at cost plus surcharge for child
Blck Sign	Record number of meals at cost and service branches
OR	Record meal at cost, name, SSN, service branch, card issue number/reason
Decline	Record name, SSN, service branch, card issue number/reason
Tot and Cash Customer Type (COMRAT, Child, etc.)	Display cumulative food costs and surcharge data for cash customer type
Reason Type (5 numeric keys)	Record reason credit customer is without a card
Numeric Keys (0-9)	Record SSN
Clear	Clear keyed data
Enter	Enter keyed data

TABLE 9. POS Terminal Backup Functions.

- Terminal automatically logs data - if computer fails to respond within 10 seconds
- Terminal operates for 30 minutes given main electrical power failure
- Logged data stored in buffer allowing up to 1,578 12-character transactions
- Message is generated when buffer is full
- Data is retained given main electrical power or UPS failure

TABLE 10. Communication Hardware Required for POS Terminals.

2096 4-line adaptor (4-port serial card)
2095 8-line controller (badge readers only)
dedicated phone lines and line drivers/multiplexers

TABLE 11. Branch of Service Categories and Methods of Payment.

CATEGORIES OF PERSONNEL	CODE
Marine Enlisted Regular	A; B; or C
Navy Enlisted Regular	A; B; or C
Army Enlisted Regular	A; B; or C
Air Force Enlisted Regular	A; B; or C
Marine Enlisted Reserve	B; C; or G
Navy Enlisted Reserve	B; C; or G
Army Enlisted Reserve	B; C; or G
Air Force Enlisted Reserve	B; C; or G
Coast Guard Enlisted Regular/Reserve (Dept of Transportation)	B; C; or G
NROTC Midshipmen (Summer Training)	G
U.S. Naval Academy Midshipmen	G
National Guard Enlisted	F
Marine Corps Junior Reserve Trng Cadet (MCJROTC)	F
Local Nationals	F
Contract Personnel (Civil Service, FdSvc Attendants)	B

Explanation of Codes

A. Subsistence at Government Expense (SIK)
B. COMRATS (Food cost only); cash payment
C. Food Cost (Regular) plus surcharge; cash payment
D. Food Cost (Under 12); cash payment
E. Food Cost (Under 12) plus surcharge; cash payment
F. Billed on NAVCOMPT 2277 Form by Local Command
G. Billed by HQMC (Considered SIK)
H. Based on Invitational Travel Orders; SIK
I. Based on Invitational Travel Orders, COMRATS, cash payment

TABLE 11. Branch of Service Categories and Methods of Payment (cont'd).

CATEGORIES OF PERSONNEL	CODE
CIVILIANS	
Nonprofit Youth Groups (i.e., Boy/Girl Scouts)	B
Nonprofit Youth Groups (Children under 12)	D
Nonprofit Youth Groups, Chaperon	B
Youth Conservation Corps (YCC)	G
Foreign Enlisted	H or I
Foreign Officers	C
Foreign Civilians	C
National Guard Officers	C
Chaperons	C
Officer Pay Checkage (OPC)	
Marine	A
Navy	G
U.S. Air Force Academy Cadets	B
U.S. Army Academy Cadets	B
U.S. Navy Academy Midshipman, Orientation	B
U.S. Coast Guard Midshipman	B

Explanation of Codes

A. Subsistence at Government Expense (SIK)

B. COMRATS (Food cost only); cash payment

C. Food Cost (Regular) plus surcharge; cash payment

D. Food Cost (Under 12); cash payment

E. Food Cost (Under 12) plus surcharge; cash payment

F. Billed on NAVCOMPT 2277 Form by Local Command

G. Billed by HQMC (Considered SIK)

H. Based on Invitational Travel Orders; SIK

I. Based on Invitational Travel Orders, COMRATS, cash payment

TABLE 11. Branch of Service Categories and Methods of Payment (cont'd).

CATEGORIES OF PERSONNEL	CODE
Officer Candidate Class (OCC)	A
Enlisted Candidates Program (ECP)	A
Marine Enlisted Commissioning Program (MECP)	A
Women Officer Candidate Class Senior (WOCC-Sr)	A
Platoon Leaders Class (PLC)	G
Women Officer Candidate Class Junior (WOCC-Jr)	G
Army Reserve Officer Trng Cadets (AROTC)	B
Air Force Reserve Officer Trng Cadets (AFROTC)	B
Navy Junior Reserve Officer Trng Cadets (NJROTC)	B

NOTE: "Sea Bees" are Navy Personnel (and can be either Regular/Reserved). Delayed Entry Poolee (DEP) are treated like civilians (Food Cost plus Surcharge).

Explanation of Codes

A. Subsistence at Government Expense (SIK)

B. COMRATS (Food cost only); cash payment

C. Food Cost (Regular) plus surcharge; cash payment

D. Food Cost (Under 12); cash payment

E. Food Cost (Under 12) plus surcharge; cash payment

F. Billed on NAVCOMPT 2277 Form by Local Command

G. Billed by HQMC (Considered SIK)

H. Based on Invitational Travel Orders; SIK

I. Based on Invitational Travel Orders, COMRATS, cash payment

Headcount Entitlement Procedure. The access control procedure is outlined in Figure 16 and Table 12. Customers who receive SIK and who pass the badges through a magnetic stripe slot reader enter the dining facility as credit customers. These are the most frequent customers and are the easiest to process. Should there be an infraction message and the message is overridden, the individual is admitted to the dining facility as a credit customer. However, if the override is declined (the infraction message is not overridden), the individual is admitted only as a cash customer. Infractions are listed in Table 13. Three of the six listed infractions (for example, SSN not on file) can be overridden. Customers have 1 working day plus adjacent weekends or holidays to correct the infraction.

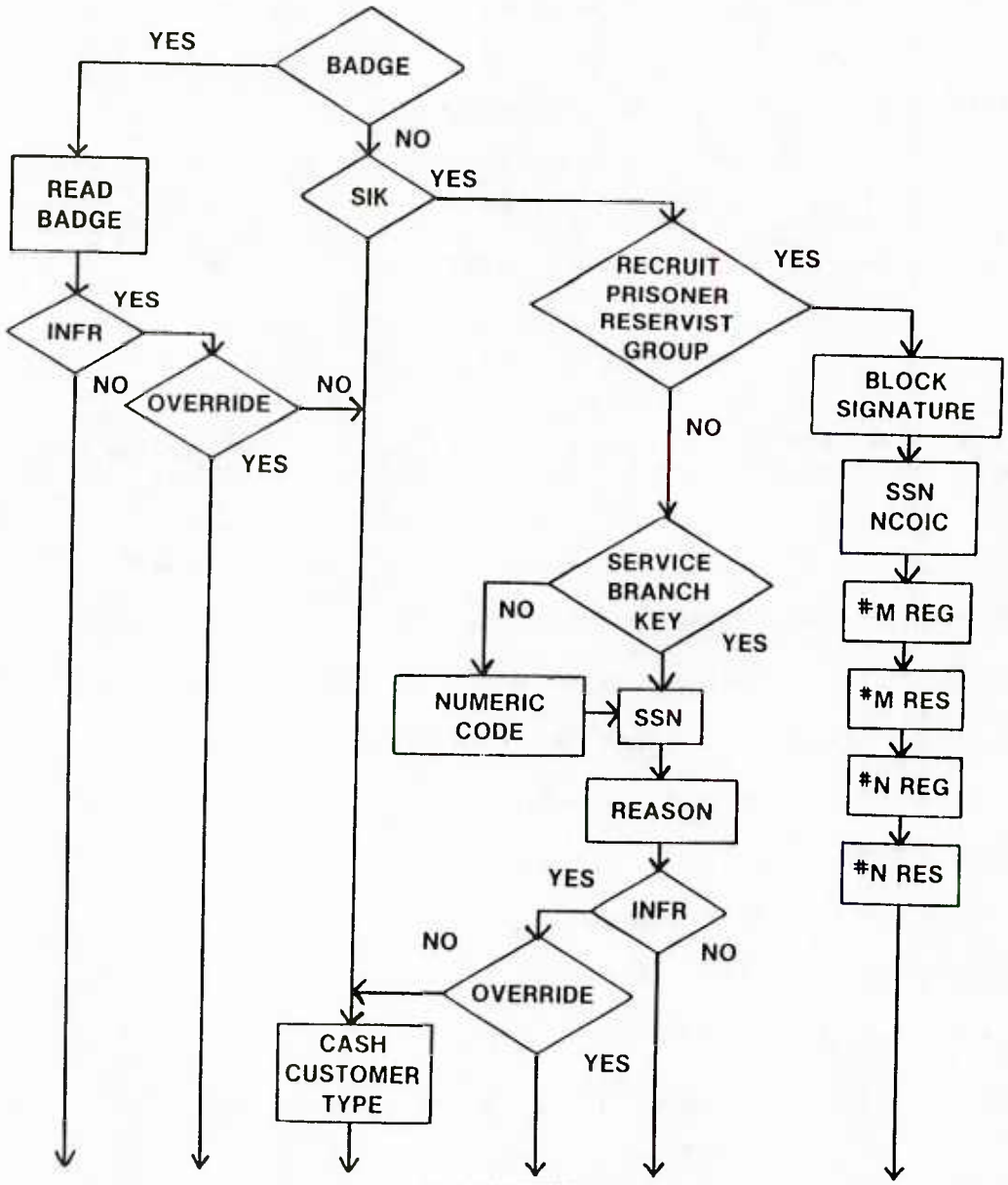


Figure 16. Access control procedures.

TABLE 12. Validation Program Functions.

TYPE OF TRANSACTION AT CARD READER	DATA RECORDED IN SERIES/I FILE	POSSIBLE MESSAGE DISPLAYED AT READER
Credit Customer (SIK) With Valid Card	SSN, Branch Code, Card Issue No., No. of Customers, Cum. Dollar Amount	Good SSN Not on File Reported Missing* Major Meals Inf.* Dining Hall Inf.* Wrong Issue No. Wrong Branch Code
Credit Customer (SIK) Without Card	Branch Code, SSN, Reason Code (Lost, Missing, New, Won't Read, Temporary) No. of Customers, Cum. Dollar Amount	Good SSN Not on File Major Meals Inf.* Dining Hall Inf.* Day Limit Ex.*
Override (Credit Customer Without Valid Card)	SSN, Branch Code & Card Issue No. or Reason Code, No. of Customers, Cumulative Dollar Amount	Overridden Declined
Group Feeding (GF) (Credit Customers W/O Cards: Reservists, Recruits, Prisoners)	No. of Customers by Branch Code, SSN, and Branch Code of NCOIC	Prompts for ?
Cash Customers	No. of Customers By Type (COMRAT, Surcharge, Child), Cum. Dollar Amount By Customer Type (Surcharge Customer By Meal Cost and Surcharge)	Meal Price
Request Total By Cash Customer Type		Cum. Dollar Amount By Customer Type

Produces Reports Summarizing and Displaying Recorded Data

*Cannot override.

TABLE 13. Card Infraction Messages.

Message	Occurrence
SSN Not on File*	User's SSN is not on file.
Major Meals Inf	User has received meals under SIK at more meal periods than authorized.
Missing Card	User's card is on record as missing.
Dining Hall Inf	User attempts to receive more than one meal under RIK in the same meal period.
Wrong Card Issue #*	User has had a card read and card issue number is less than the card issue number in the master SIK file.
Wrong Branch Code*	Branch code on card does not correspond to branch code on file.

*Manual override available; 1-day limitation schedule. All others cannot be overridden.

Customers who do not have badges and do not receive SIK are cash customers. Cash customers are processed by the cashier who receives money, ensures that the customers sign the Paid Supernumerary Ration Register, and enters into the POS terminal the cash customer type (COMRAT, child, etc.). Cash customers include personnel receiving COMRATS, dependents, individuals on per diem, officers, and civilians, other than dependents who are entitled to eat in a government dining facility. Cash customers are required to sign a ration register to verify that they are entitled to eat in a dining facility. To avoid delays in line during peak customer periods, cash customers can be processed separately from SIK customers.

Customers who do not have badges but who are credit (SIK) customers are processed either individually or in groups. Individual credit customers without valid badges are the least frequent customers but the most difficult to process. The cashier is required to enter the customer's service branch (Table 10), SSN, and reason for not possessing a valid card. Acceptable reasons for not having a meal card are given in Table 14. The customer is required to possess a valid military identification and, if he/she is new on base, to possess orders authorizing him/her to eat at government expense. Infraction messages for credit customers without valid meal cards are also given in Table 14. These customers are given 1 working day plus adjacent weekends and holidays to obtain a card.

Credit customers are processed in groups if they are recruits or prisoners. Reservists who physically appear at the dining facility in groups may also be processed in groups providing they are not on active duty for training (ADT) for longer than 5 days. If they are ADT for longer than 5 days they are required to have valid meal cards. Reservists who are not fed in groups are treated as

TABLE 14. Credit Customers Without Cards: Reasons, Day Limitation Schedule, and Infraction Messages.

Reasons for Credit Customers Without Card

Reason	Occurence
Forgotten	User has forgotten his card
Missing Card	User reports card as lost or stolen
Card Won't Read	User's card is damaged or worn
New on Base	User has just arrived on base
Temporary	User plans to be on base for less than 6 days

Day Limitation Schedule

Reason	No. of Days Credit Authorized Without Card[a]
Forgotten Card	1
Missing Card	1
Card Won't Read	1
New on Base	1
Temporary	5

Possible Infraction Messages for Individuals Without Cards

Message	Occurence
SSN Not on File	User's SSN is not on file[b]
Major Meals Inf	User has received meals under SIK at more meal periods than authorized
Dining Hall Inf	User has attempted to receive more than one meal under SIK in the same meal period
Day Limit Exceed	User has exceeded the number of days he is entitled to receive meals as a credit customer without a valid meal card

[a]The day limitation schedule is adjusted for weekends when new cards would not be available. If, for example, an individual arrives on Friday evening or Saturday, he would be allowed 3 days and, if on a Sunday, 2 days. If Monday or Friday were holidays, he would be allowed an additional day.

[b]Manual override is available if the individual is new on base.

regular Marines who do not have a valid meal card. The cashier processes groups by entering the group's NCOIC's SSN and the number of credit customers by branch of service.

Reports. The module was designed to generate two reports. The Revenue Report was designed to provide the number and gross dollar amount of cash transactions and cash transactions by customer type. The Exceptions Report was designed to list the names (if on file), social security numbers, and branches of service of individuals who did not possess valid meal cards and who received a meal without paying cash during the report period. The reason for which each individual was admitted is printed.

Master SIK File Updating. The Master SIK File was developed to store data for validating meal cards on a real time basis at the headcount stations and would require updating daily to indicate changes in the duty status of personnel attending the messhalls. The file would also require updating information on individuals beginning a subsistence allowance. Only individuals present for duty and who receive SIK are entitled to subsist at government expense in base dining facilities. All other categories of individuals (changed duty station, jailed, hospitalized, on leave, ADT, etc.) are not entitled to subsist at government expense.

An automated procedure for updating the Master SIK File on a daily basis would require that a participant's duty status, along with other data needed for the Master SIK File, be made available in files resident in CPDA's mainframe Amdahl V7 for the automated transfer either directly to the food service office IBM 4956 Model B Series/1 minicomputer or to a floppy disk compatible with the EDX operating system and an IBM 4964 diskette unit. Customer data must be formatted to meet the file specifications for the Master SIK File.

An updating procedure may be required only for individuals beginning a subsistence allowance if personnel are required to turn their cards in whenever there are changes in their duty status. Participants going on leave, for example, would be required to turn in their meal card to their company commanders prior to picking up their leave papers. The need for updating SIK status may be eliminated if the magnetic stripe meal cards contained all the necessary information required for constructing the SIK file, and the information on the cards is used to build the file. The file would be constructed as new cards were used in the dining facilities. However, this process would require an additional procedure to prevent the use of unauthorized cards that met ABA standards.

Hardware. Hardware and hardware costs are given in Table 1. Costs are broken out by terminal, peripheral equipment, and a one time cost for Mylar®* silk screen (overlay).

System Timing Requirements

Timing refers to the amount of processing that the system must do in a given period of time (throughput), and the response time required during on-line opera-

*Mylar® is a registered trademark of E.I. DuPont de Nemours and Company. Citation of trade names does not constitute an official endorsement or approval of the use of such items.

tions. Throughput system workload would be quite heavy during mealtimes when access control/headcount processing, inventory updating, and processing to prepare for the next meal may be occurring concurrently. The system must be able to process multiple functions at the same time and at a speed that will support the required access control response time, the required on-line update response time, and the processing required prior to the next meal. The response time for access control should not be more than 6 seconds (i.e., no more than 6 seconds should elapse between the time an ID card is read and a response to the reader is displayed). The response time for a single function on-line update should be no more than 1 second (i.e., when the inventory level of a single ingredient is updated, the time between depressing the "enter" key and the start of the display of an update confirmation message should be no more than 1 second). The response time for major functions such as producing the "Cook's Worksheet" would vary with the function because of variations in the size of the menu, by day and by meal.

Failure Contingencies

Given a host computer failure, the POS terminal was capable of recording up to 1,578 transactions. Under conditions of a main electrical power failure, the POS terminal was capable of recording transactions for up to 30 minutes. Should the number of transactions exceed 1,578 under conditions of a computer failure or should there be a power failure for longer than 30 minutes, a manual system should be used.

AUTOMATED SYSTEM IMPACT

Procedures

The MCAFSOS was installed in the three dining facilities and the Food Service Office in January 1986, and though the test began in May, the actual implementation of the programs in the messhalls was both gradual and slow. Progress was hampered by both programming and food service personnel shortages. At the completion of the test, however, the Cook's Worksheet, Product Sheet, Produce Requirement Sheet, Subsistence Issue Receipt, Man-Days Fed Report, Stock Record and Inventory Control Card, Certificate of Survey, Financial Status of Dining Facility, Food Cost Analysis, the recording of receipts, transfers, and turn-ins, the forecasting procedure, and the monthly inventory procedure to include letters of adjustment were automated. The Armed Forces Recipe Service and the Master Menu for the calendar year were also automated. At the Food Service Office level routines for the Subsistence Operational Analysis Report, the Consolidated Man-Days Fed Report, the Consolidated Financial Status of the Dining Facility, and the Computation of the Basic Daily Food Allowance were installed. While these procedures were coded and installed, they were not field tested. Automated functions were supported by the Security and Directory Module, the System and FSO Functions Module, and the File Maintenance Module. The System and FSO Functions Module included procedures for storing reports, for backing up and restoring the data base, for eliminating outdated records, and for editing user privileges, and it provided an audit trail of users.

The impact of the automated system on food service was assessed through work samplings and survey. Work sampling data was collected 22-24 October 1985 and 21-23 October 1986 in Messhalls 2000 and 5000, and survey data was collected 21-23 October 1986 in all three messhalls. Also, predicted and actual attendance rates for two of the three messhalls for July 1985 were compared with the predicted and actual attendance rates for the same messhalls for July 1986.

Survey data were captured on the MCAFSOS Acceptance Questionnaire. The questionnaire, developed for the MCAFSOS test and presented in Appendix A, consisted of 11 scaled items, several general time-related items, and several open-ended items designed to elicit food service worker opinions about the effectiveness of the system. The scaled items were designed to assess the effectiveness of the system, the ease or difficulty involved in learning and using the system, and whether the system improved food service accountability. In addition, respondents were asked to estimate how much time was typically required each day to complete food service forms that pertained to their jobs under the manual system, and how much time was required each day to complete the same forms under the automated system. Respondents were limited to those who used the system.

Work samples were taken every 10 minutes, between 0330-1730 hours, for 3 consecutive days from managers, subsistence clerks, and chief cooks, both prior to and during the test. Work sampling data, collected to supplement the survey data, provided an indication of how much time personnel spent on completing each of the tasks that made up their jobs.

Though an objective technique, work sampling data, like survey data, do not provide precise time estimates. Codes used to categorize activities are given in Appendix B. A number of variables inherent in collecting work sampling data

are difficult to control and introduce a margin of error. For example, work sampling data are sensitive to the interval between observations. A task begun and completed between observations may not be recorded, and a task that overlaps into a subsequent interval, but is completed prior to the end of the interval, may be recorded as requiring all of that interval. Also, tasks that are interrupted or abandoned for some period and then begun again, may be recorded as requiring more time than actually required. Consequently, work sampling data provide only rough indications of how individuals distribute their time among tasks.

Worker Assessments

Results from the MCAFSOS Acceptance Questionnaire are given in Tables 15 and 16. Eleven Marine Corps food service personnel with an average of approximately 4 months of experience using the computer completed the questionnaire. Overall, respondents indicated that the system was satisfactory. Further, they indicated that the system was easy to learn and use, that it was moderately better than the manual system, and that they "liked moderately" using the computer. However, respondents also indicated that food service accountability was neither better or worse and that the system needed a moderate amount of improvement. Because the Automated Headcount/Access Control Module was not used, no appreciable perceived increase in food service accountability would be expected.

Sixty-four percent of the food service personnel reported they spent less time on food service forms when using the automated system than when using the manual system. (Because the manual recording of inventory data was maintained in each of the messhalls while the automated system was being implemented, some individuals experienced an increase in the amount of time spent processing food service forms). Almost 6 hours were needed in a messhall to complete forms and records each day, with the subsistence clerks using the computer the most (3 hours and 45 minutes) and the managers using it the least (35 minutes). However, these estimates are conservative because not all of the automated routines were being used when this data was collected.

Worker Comments

Comments, with minor editing, given in response to three open-ended questions on the Acceptance Questionnaire, are given in Appendix C. Seven of the ten comments made in response to the question, In what way is the automated system better or worse than the manual system? were positive and indicated that the system was much simplier and faster than the manual system. In response to the question, How can the automated system be improved? food service personnel most frequently indicated that the system failed too often. These latter responses are consistent with those indicating that the system needed improvement.

Numerous problems were encountered while implementing the automated system. Software problems, for example, prevented the use of programs, resulted in locked files, or produced reports with incorrect information or information that was difficult to use. Incomplete files, outdated files, or files with incorrect information often caused the food service worker to do extra work. Most of these problems, however, were resolved.

In response to the question, How has the food service accountability been made better or worse by the automated system? one food service worker indicated that while the system was very good, the end of the month inventory never corres-

TABLE 15. Worker Assessment of the Automated System.

11 respondents using 7-point scale

Items	Arithmetic Mean	Standard Deviation
Better or Worse Than Manual System 1 = Extremely Better	2.45 Moderately Better	1.13
Easy or Difficult to Learn 1 = Extremely Easy	1.27 Extremely Easy	0.47
Easy or Difficult to Use 1 = Extremely Easy	1.36 Extremely Easy	0.50
Food Service Accountability Better or Worse 1 = Extremely Better	4.00 Neither Better or Worse	1.67
Like or Dislike 1 = Like Extremely	2.54 Like Moderately	1.69
Satisfactory or Unsatisfactory 1 = Completely Satisfactory	3.00 Satisfactory	0.89

11 respondents using 4-point scale

Items	Arithmetic Mean	Standard Deviation
Needed Improvement 1 = OK As Is	2.82 Needs Moderate Amount	0.75

TABLE 16. Self-Report Estimates of How Much Time Was Spent on the Computer Each Day.

Averaged across three messhalls

	Hours	Minutes
Managers (n=3)	0	35
Computer/Subsistence Clerks (n=4)	3	45
Chief Cooks (n=4)	1	20

ponded with the actual inventory and implied the lack of correspondence was due to the system. This problem, and others like it, resulted when files were allowed to become outdated. In order for the end of the month inventory routines, or any program that accessed these files, to work properly all issues, receipts, surveys, transfers, and turn-ins must be accurately and reliably entered. Failure to keep files current will result in problems. Failure to update fixed prices, for example, will result in an inaccurate food cost analysis.

A second respondent indicated that accountability was worse because mistakes could not be corrected while using the Subsistence Issue Receipt. The Subsistence Issue Receipt does provide for editing incorrectly entered data. The program prompts users to verify their entries item by item. However, once the routine is completed, corrections cannot be immediately made, though they can be made the following day. A program option should be provided to allow the correction of this kind of mistake on the same day it is made.

Time Savings

Work sampling data are summarized in Table 17. Self-report estimates of the amounts of time required to complete tasks are summarized in Table 18. Work sampling data were collapsed across food service personnel. The averaged times required for personnel to complete forms under the manual system were combined and then compared with the time needed to produce each form using the automated system (Table 17). This was done because while the managers and chief cooks used the computer (estimated time 0-60 minutes each day) most of the automated forms were generated by a single individual, either the subsistence clerk or a "computer clerk", who spent the majority of the day using the computer (4 to 7 hours each day).

As indicated in both tables, there was an average reduction of 61 minutes in the amount of time required to complete a food service form using the automated system. There was a 55% (questionnaire) to 76% (work sampling) reduction in the amount of time required to complete or use food service forms that were used on a daily basis (Table 17). The greatest time savings were for the Stock Record and Inventory Control Card (which was totally automated), the Cook's Worksheet, and the Product Sheets. The Stock Record and Inventory Control Card is automatically created as issues, receipts, and turn-ins are recorded. Meal plans and quantities of food to withdraw from the inventory are automatically provided on the Cook's Worksheet, and recipe ingredient quantities for the forecasted number of servings of each menu item are provided on the Product Sheet.

Automated Forecast

Results relevant to the usefulness of the automated headcount forcast were mixed. Attendance rates, given in Tables 19 and 20, tended to be predicted more accurately under the manual system than under the automated system in Messhall 2109. In each case (breakfast, lunch, and dinner) the difference between the predicted attendance and actual attendance was smaller using the manual system. Only two of the correlations were significant, however, suggesting that predictions tended to be poor regardless of the system. In Messhall 2000, attendance rates tended to be more accurately predicted using the automated headcount forecast. The differences between the predicted and actual attendance were smaller using the automated system in two of the three cases. All of the correlations were significant suggesting that some of the variability in messhall attendance was accurately predicted regardless of the system.

TABLE 17. Work Sampling: Time Distribution in Minutes for Personnel Under the Manual and Automated Systems.

	Manual	Automated	Difference	Percent Difference
Master Menu	35	0	35	100
Cook's Worksheet	159	27	132	83
Product Sheets	143	28	115	80
Produce Requirement Sheet	18	15	3	17
Subsistence Issue Receipt*	78	96	+18	+23
Stock Record & Inventory Control Card	201	0	201	100
Man-Days Fed Report	39	10	29	74
Food Cost Analysis	79	3	76	96
Total Time:	752	179	573	76

*This program does not allow the immediate correction of mistakes in the automated system, thus the observed increase in time required to complete the task in a careful manner (see pg 49, ¶2).

TABLE 18. Self-Report Estimates of How Much Time Was Required to Complete Forms Under the Manual and Automated Systems.

	Number of Respondents	Ave Time (min) Manual	Automated	Average Difference	Percent Difference
Cook's Worksheet	7	84	23	61	73
Product Sheets	6	106	17	89	84
Produce Requirement Sheet	5	32	7	25	78
Subsistence Issue Receipt	4	78	59	19	24
Man-Days Fed Report	3	13	12	1	8
Monthly Inventory	4	195	112	83	43
Total Time:	-	508	230	278	55

TABLE 19. Forecasted and Actual Attendance at Messhall 2000.*

	Average Attendance Actual	Predicted	Difference	Correlation
Breakfast				
Pretest (31)	261	286	-25+	.37+
In-Test (50)	228	228	0	.38+
Lunch				
Pretest (21)	400	427	-27+	.49+
In-Test (58)	250	238	12+	.57+
Dinner				
Pretest (31)	328	354	-26+	.82+
In-Test (50)	335	283	52+	.57+

*Number of days forecasted are in parentheses.

+ t test, two tailed, level of significance $\leq$ .05.

TABLE 20. Forecasted and Actual Attendance at Messhall 2109.*

	Average Attendance Actual	Predicted	Difference	Correlation
Breakfast				
Pretest (29)	97	101	-4	.26
In-Test (73)	85	110	-25+	-.02
Lunch				
Pretest (21)	137	148	-11+	.39
In-Test (61)	123	187	-64+	.56+
Dinner				
Pretest (31)	110	137	-27+	.86+
In-Test (73)	98	161	-63+	.19

*Number of days forecasted are in parentheses.

+ t test, two tailed, level of significance $\leq$ .05.

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APPENDIX A.

Data Collection Forms

MARINE CORPS AUTOMATED FOOD SERVICE OPERATIONS SYSTEM TEST
ACCEPTANCE QUESTIONNAIRE

Please help us evaluate the automated food service operations system by answering the following questions.

Rank _____

Job Title _____

How long have you been using the automated system? _____

Is the automated system Better or Worse than the manual system? (check one)

_____ Extremely Better
_____ Moderately Better
_____ Slightly Better
_____ Neither Better or Worse
_____ Slightly Worse
_____ Moderately Worse
_____ Extremely Worse

In what way is the automated system better or worse than the manual system?

_____
_____
_____
_____

Do you spend More Time or Less Time preparing food service forms using the automated system than when you used the manual system?(check one)

_____ Less Time
_____ More Time

How much more or less time do you spend preparing forms? _____

About How Much Time do you spend on the computer each day? (check one)

_____ 0 min
_____ 15 min
_____ 30 min
_____ 1 hr
_____ 1½ hr
_____ 2 hr
_____ 3 hr
_____ 4 hr
_____ 5 hr
_____ 6 hr
_____ 7 hr
_____ 8 hr

How Easy or Difficult was it to learn to use the automated system? (check one)

_____ Extremely Easy
_____ Moderately Easy
_____ Slightly Easy
_____ Borderline
_____ Slightly Difficult
_____ Moderately Difficult
_____ Extremely Difficult

How Easy or Difficult is it to use the computer? (check one)

_____ Extremely Easy
_____ Moderatley Easy
_____ Slightly Easy
_____ Borderline
_____ Slightly Difficult
_____ Moderately Difficult
_____ Extremely Difficult

Has the automated system made food service accountability Better or Worse?

_____ Extremely Better
_____ Moderately Better
_____ Slightly Better
_____ Neither Better or Worse
_____ Slightly Worse
_____ Moderately Worse
_____ Extremely Worse

How has the food service accountability been made Better or Worse by the automated system?_____
_____ _____
_____
_____

How much do you Like or Dislike using the computer? (check one)

_____ Like Extremely
_____ Like Moderately
_____ Like Slightly
_____ Neither Like or Dislike
_____ Dislike Slightly
_____ Dislike Moderately
_____ Dislike Extremely

How much improvement does the automated system need? (check one)

_____ OK As Is
_____ Needs a Slight Amount of Improvement
_____ Needs a Moderate Amount of Improvement
_____ Needs Quite a Bit of Improvement

How can the automated system be improved? _____
_____
_____
_____

Overall, how Satisfactory or Unsatisfactory is the automated system? (check one)

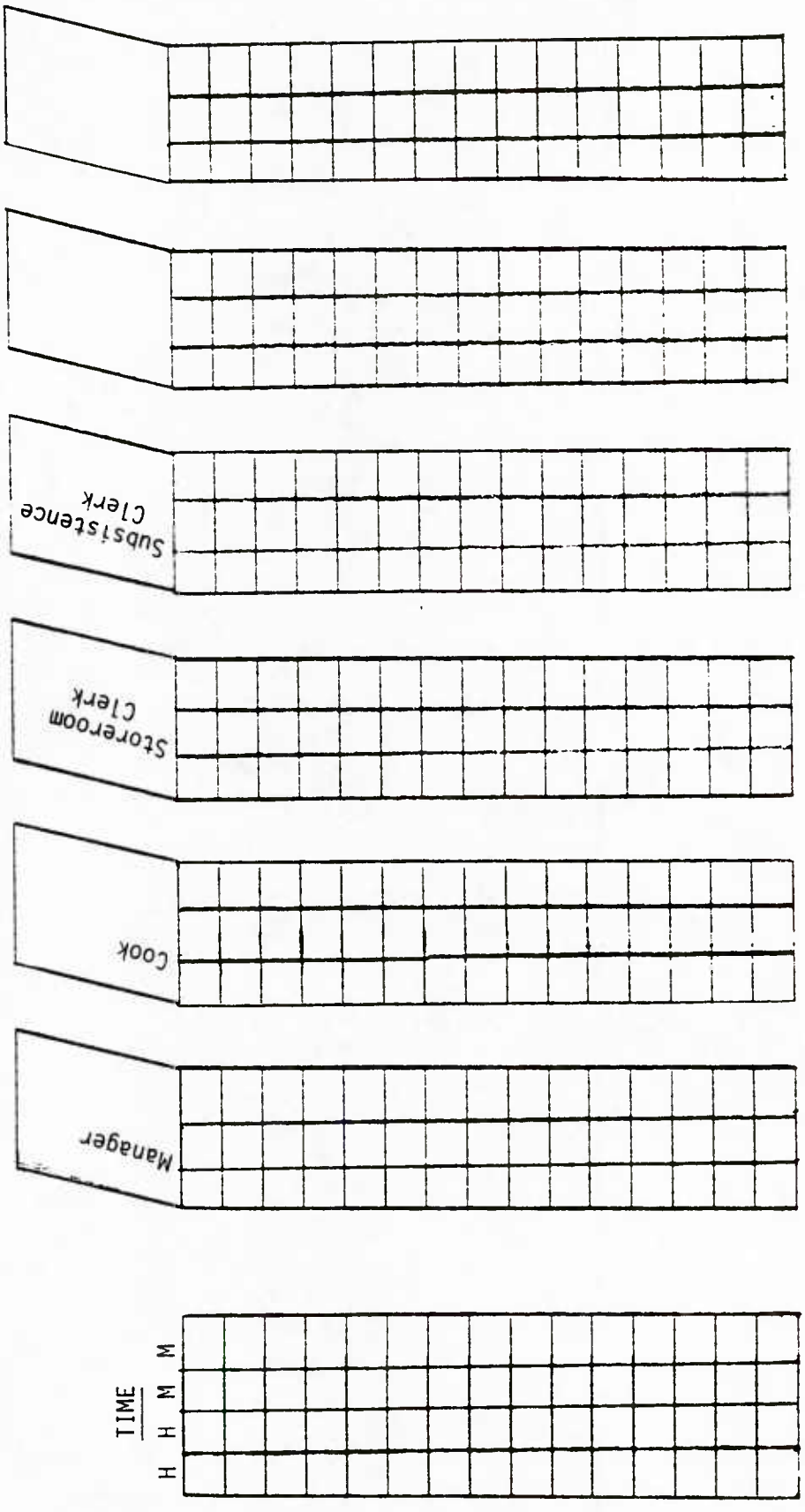
_____ Completely Satisfactory
_____ Very Satisfactory
_____ Satisfasctory
_____ Borderline
_____ Unsatisfactory
_____ Very Unsatisfactory
_____ Completely Unsatisfactory

MARINE CORPS AUTOMATED FOOD SERVICE OPERATIONS SYSTEM TEST

Please help us evaluate how the automated food service operations system has affected you by estimating how much time each day is/was typically required to complete forms or record information that pertains to your job under the old system and how much time each day is now required to complete the same forms or record the same information using the automated system.

FORM	TIME NEEDED TO COMPLETE UNDER OLD SYSTEM	NEW SYSTEM
Cook's Worksheet(pre and post)	_____	_____
Subsistence Issue Reciept(pre and post)	_____	_____
Produce Requirement Sheet	_____	_____
Product Sheets	_____	_____
Master Menu	_____	_____
Financial Status of Dining Facility	_____	_____
Food Cost Analysis	_____	_____
Man-Days Fed Report	_____	_____
COMRAT Sheets	_____	_____
Meal Signature Sheets	_____	_____
Dining Facility Requisitioning (weekly)	_____	_____
Inventory	_____	_____
Stock Record and Control Card	_____	_____
Receiving	_____	_____
Transfers	_____	_____
Surveys	_____	_____
Turn-Ins	_____	_____

WORK SAMPLING DATA RECORD SHEET



APPENDIX B.

Definitions of Activity Codes

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Definitions of Activity Codes

Code	Activity Description
01	Preparation - The obtaining, mixing, cutting, chopping, etc., of all ingredients used for salads, meat, and vegetable production. The general preparation of all food products.
02	Cooking - All actual activities involved in the art of cooking. For example, selecting proper temperature setting, monitoring food being cooked or reconstituted, seasoning, placing and removing food from containers, cooking food on grill or oven.
03	Serving - This activity is related to activities associated with the serving line outside the purvey of "cooking". These include plating meals, setting up and breaking down serving line, replenishing the line. This also includes the time spent in position ready to serve even though there are no customers.
04	Sanitation - This encompasses all aspects of cleaning, trash disposal, and sanitation in all food service areas. For example, dishwashing, pot and pan washing, the placing of these wares into their proper receptacles, and equipment sanitation.
05	Supply - This includes the movement of supplies from the storage area as well as receiving, unpacking, etc., of these supplies from outside sources. All inventory manipulation, internal issuance of supplies, and replenishment of all beverage equipment.
06	Administration - This includes the drafting and typing of correspondence and the maintenance of civilian employee personnel and pay records. This category includes answering the telephone and paging personnel as well as changing menu boards for upcoming meals. This does not include supply administration or report preparation.
07	Maintenance - Preventive or corrective maintenance done on any piece of equipment necessary for the completion of the food service mission. This category includes burner maintenance.
08	On-The-Job Training - This task involves knowledge and/or skills being taught to an individual in a planned, structured manner. The observer should look for demonstrations, explanations, practice sessions, and self-instructional activities.

09 Supervision - This includes review of the present system by supervisor in procedures and methods, as well as inspection and monitoring of food service areas/personnel, including giving instructions.

10 Picking Up/Delivering Supplies - This includes the acquisition of supplies that may include food or expendables (paper products, office supplies, etc.) for use at the work location.

11 Other Productive.

Menu Production

12 Cook's Worksheet NAVMC 36 (Pre and Post)
13 Subsistence Issue Receipt NAVMC 10568 (Pre and Post)
14 Product Sheet NAVMC 10616
15 Cook's Produce Requirement Sheet NAVMC 10615
16 Master Menu for Calendar Year
17 Armed Forces Recipe Service MCO P10110.16C. Rev

Accounting

18 Financial Status of Dining Facility NAVMC 584
19 Food Cost Analysis
20 Man-Days Fed Report NVMC 565-1

Inventory

21 COMRAT Sheets NAVMC 10298
22 Meal Signature Record NAVMC 10789
23 Inventory Requisition and Issue NAVMC 10815-10819, 10941
24 Inventory Programs
25 Taking Inventory
26 Stock Record and Inventory Control Card NAVMC 708
27 Physical Breakout
28 Physical Return
29 Breakout Sheets
30 Receiving
31 Transfers
32 Certificate of Survey
33 Turn-Ins

34 Forecasting
35 Report Preparation
36 File Maintenance
37 Other Forms
38 Nonproductive

APPENDIX C.

Food Service Worker Comments

APPENDIX C.

Food Service Worker Comments

IN WHAT WAY IS THE AUTOMATED SYSTEM BETTER OR WORSE THAN THE MANUAL SYSTEM?

"The automated system keeps premenus on file so if you are missing one you don't have to write it over."

"The automated system is quicker than having to write out a full menu. The man-hours saved are the most significant change in preparation and posting."

"The automated system is extremely better in that it is faster and more accurate. However, some of the programs should be looked at."

"The automated system makes the chief cook's work a lot easier and it gives him more time to supervise the troops."

"The automated system is worse due to the fact that the system needs to be updated."

"The automated system is worse because it breaks down so much. You end up going back and forth."

"The automated system is better because of the time saved."

"The automated system is better because it saves a lot of time."

"The automated system is worse because you cannot depend on the information that you put in being there when you need it back. Also, because it goes down a lot it creates a lot of back log work."

"The automated system is better because it is much simplier."

HOW HAS THE FOOD SERVICE ACCOUNTABILITY BEEN MADE BETTER OR WORSE BY THE AUTOMATED SYSTEM?

"The accountability now is worse because it does not leave much space for mistakes and corrections."

"The system is very good but the end-of-the-month inventory accountability on the computer never matches with the actual inventory. And I can guarantee that this is not all due to human error."

"The accountability is better because you don't have to spend much time doing forms. The computer does them for you."

"The accountability is better because there is less chance of forgetting to carry over leftovers."

HOW CAN THE AUTOMATED SYSTEM BE IMPROVED?

"The computer could be faster and hold the premenu longer. If you mess up, you have to do another one."

"The system should not break down so often."

"The system needs to be updated."

"A more advanced computer system, something that has more memory and has a faster printout, would save even more time."

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